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Permanent Secretary Denison Scientific Association

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- The contribution of Astronomy to general culture; Edward B. Frost. 12 pp.
- The geological development of Ohio; F. Carney. 15 pp.
- The relief features of Ohio; F. Carney. 13 pp., 1 fig.
- Geographic conditions in the early history of the Ohio country; F. Carney. 20 pp.

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- A geographic interpretation of Cincinnati, Ohio; Edith M. Southall. 16 pp.
- Strophomena and other fossils from Cincinnatian and Mohawkian horizons, chiefly in Ohio, Indiana, Kentucky; Aug. F. Foerste. 158 pp., 18 plates.
- Population centers and density of population; F. Carney. 15 pp.
- The climate of Ohio; F. Carney. 9 pp.

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- Some pre-glacial lake shorelines of the Bellevue Quadrangle, Ohio; F. Carney. 16 pp., 3 figs.

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- Lorraine faunas of New York and Quebec; Aug. F. Foerste. 93 pp., 5 plates.
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- The Locust Grove Esker, Ohio; James D. Thompson, Jr. 4 pp., 1 fig.
- Notes on Agelacrinidae and Lepadocystinae, with descriptions of Thresherodiscus and Brockocystis; Aug. F. Foerste. 88 pp., 6 plates.

VOLUME 18

Articles 1–3, pp. 1–284; December, 1915.....$1.75
- Proceedings of the inauguration of President Chamberlain. 54 pp.
- Denison University presidents; William Hannibal Johnson. 5 pp.
- The fauna of the Morrow Group of Arkansas and Oklahoma; Kirtley F. Mather. 226 pp., 2 figs., 16 plates.

Articles 4–7, pp. 285–378; December, 1916.....$1.00
- Notes on Cincinnatian fossil tyres; Aug. F. Foerste. 71 pp., 7 plates.
- The shorelines of glacial lakes Lundy, Wayne, and Arkona, of the Oberlin Quadrangle, Ohio; Frank Carney. 6 pp. 1 fig.
- The progress of Geology during the period 1891–1915; Frank Carney. 8 pp., 4 figs.
- The abandoned shorelines of the Ashtabula Quadrangle, Ohio; Frank Carney. 24 pp., 4 figs.

VOLUME 19

Articles 1–4, pp. 1–64; April, 1919.....$0.75
- Echinodermata of the Brassfield (Silurian) formation of Ohio; Aug. F. Foerste. 30 pp., 7 plates.
- America's advance in potash production; W. C. Ebaugh. 14 pp., 2 figs.
- The use of outline charts in teaching vertebrate paleontology; Maurice G. Mehl. 8 pp., 1 fig., 4 plates.
- Some factors in the geographic distribution of petroleum; Maurice G. Mehl. 9 pp., 2 plates.

Articles 5–8, pp. 65–146; September, 1919.....$0.75
- Notes on Isotelus, Achrolichas, Calymene and Encrinurus; Aug. F. Foerste. 18 pp., 6 plates.

JOURNAL

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W. C. EBAUGH

VOLUME XXX

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DENISON SCIENTIFIC ASSOCIATION

Organized April 16, 1887

REPORT OF THE PERMANENT SECRETARY FOR THE YEAR 1934–1935

Officers of the Association during the college year 1934–1935 were as follows:

F. J. WRIGHT, *President*
M. E. STICKNEY, *Vice-President*
W. C. EBAUGH, *Permanent Secretary and Editor*
CHARLOTTE RICE, *Recording Secretary and Treasurer*
L. E. SMITH, *Librarian*

In accordance with its usual custom the Association held meetings on alternate Tuesday evenings throughout the college year. Speakers and their topics, together with slight explanatory notes, are given herewith.

October 23

LOOKING FOR AN HONEST MAN. T. A. LEWIS, Retiring President

The cue for such a search was given by Diogenes, the Greek cynic, a long time ago, but it is only in very recent times that there has been any follow-up or acceptance of the broad hint that character is worth investigating.

Finding an "honest" man is not a matter of attempting to find a perfectly honest man, but of determining how much capacity any man has to be honest, or to go straight in the face of temptation.

Three methods of reseach account for the data so far accumulated. The ambition to apply the yardstick to morals was given its initial boom by the so-called "lie detectors." Biographical study, or social clinic, has been an increasingly productive line of effort. And perhaps most fruitful of all is the "statistical" procedure, which is just now taking the lime light.

If character can be measured it will be a great boon to all educational ventures in moral education. Such education at present has small certainty about results.

November 6

THE VALUE OF COMPUTING MACHINES, WITH A DEMONSTRATION. F. B. WILEY and CHOSABURO KATO

The contributions of mathematics to solving our problems are hidden beneath the surface of things, and the layman sees only results. One such result is the computing machine of today. These machines have a forerunner in the *abacus*, a device consisting of beads strung on wires. This form of apparatus has been in use for centuries in both the Near East and Far East. A Japanese type of abacus was exhibited and its use demonstrated; such a machine is used most efficiently in oriental counting houses today.

From Babylonian times down through the eras of Greeks and Romans this apparatus has been practically unchanged. It is one of the few mechanical links uniting the very ancient with the very modern.

November 20

HEAVY HYDROGEN (DEUTERIUM) AS A TOOL IN SCIENTIFIC RESEARCH. H. L. JOHNSTON (Ohio State University)

The "heavy water" plant in operation at Ohio State University was described, the methods for separating deuterium from hydrogen outlined, and the use of this recently discovered form of hydrogen in chemical, physical and biological research explained. "Heavy Water" of varying concentrations was exhibited.

December 4

DIFFUSE MATTER IN INTERSTELLAR SPACE. FREEMAN MILLER

Clouds of glowing gases with densities a billionth that of the best vacuum produced in modern laboratories, yet which weigh as much as a hundred suns. . . . Mysterious elements that turn out to be prosaic oxygen and nitrogen under such abnormal con-

ditions that one atom meets a neighbor only after traveling several hundred miles. . . . An interstellar stratum of calcium shining in a manner only to be explained by a temperature of ten thousand degrees—while the computed temperature of space is only four degrees above absolute zero. . . . Screens of obscuring dust which shut out forever our view of whatever lies beyond. . . . A general, all-pervading dust cloud, which, in an age when the measured dimensions of our galactic system are increasing by leaps and bounds, forces us to contract them to a third of their former size. . . . Clouds of gas glowing with the reflected starlight that reaches them only after traveling for thirty years through space. . . . These are some of the more spectacular discoveries made in recent years concerning the distribution and physical state of that part of the matter in the universe not concentrated into stars. At times the astronomer is fascinated by the problems it presents; at others, condemns it bitterly for interfering with his study of whatever lies "just on the other side." In either case, however, the increase of knowledge concerning the diffuse matter scattered throughout the heavens exerts a marked influence on our conceptions of the properties of interstellar space.

December 18

GREENS FOR CHRISTMAS—A HOLIDAY LECTURE.
M. E. STICKNEY

Our celebration of Christmas includes many features of varied but precious significance. The feasting, the giving, the exchange of greetings, the decking of homes with greenery, the Christmas tree—each meaning much or little with different peoples, but nevertheless each playing its part in the festivities of the day. While Christianity has borrowed most of these features from Paganism, it has read into each one a new meaning and one of deep significance.

Why do we associate holly with Christmas? When and for what reasons did mistletoe come to have its mystic part to play in the Yuletide celebration? What does ivy mean at this time to the Briton? How did rosmary come to be linked to Christmas, and why is it losing its place at the present time? Why is the fir so dear to the German heart? What do our own people select

in order to "bring home Christmas" to their houses; and where are these evergreens produced? Such questions were raised and answered.

January 15

MODERN METHODS OF TRAFFIC ANALYSIS. B. D. GREENSHIELDS

The correct design and construction of highways, and the proper regulation of traffic, demand that highway engineers and other highway officials have a thorough knowledge of traffic behavior. Experience has shown that however well highways are constructed, this alone will not safely expedite traffic.

The automobile has brought about one of the greatest humanitarian and economic problems yet faced by the American people. Several of the newest methods of testing driving ability and of recording the movement of vehicles upon the roadway were discussed. The photographic method used to gather data, with its "electric eye" to operate the camera automatically, were described in detail, and the analysis of such data outlined.

February 5

BIOLOGY AND HUMAN WELFARE. A. W. LINDSEY

Men were men long before they were biologists; their institutions grew up without the benefit of scientific foundations. In the present development of civilization science has demonstrated abundantly its ability to add to human comfort and to advance human development. What is the ultimate goal? Do the unscientific aspects of human life promise the realization of an ideal state? Can the problems which they present be solved? Biology has many pertinent facts to offer; a few of them, of fundamental significance, were presented for consideration.

February 19

CONTRIBUTIONS OF PHYSICS TOWARD THE SOLUTION OF MODERN PROBLEMS. L. E. SMITH

In general, physicists are poor advertisers, and as a consequence the part that physics plays in modern life is neither well known nor widely appreciated. Physics has been the basis of the solutions of many of the problems of our present civilization,

and at the same time has contributed much more by way of supplying new and attractive problems for solution. The way in which a few of these contributions to progress came into being, and were developed, was pointed out. The economic and social importance and significance of these developments can readily be inferred.

March 5

SCIENCE IN THE NATIONAL RECOVERY PROGRAM. W. A. EVERHART

A recent report of the Science Advisory Board appointed by President Roosevelt dealt with the first year's operation of the Board, the studies now in progress, and recommendations with respect to future work. The functions, relationships and programs of the several scientific bureaus, and the place of science in the government structure, were discussed. In the evolution of our national life we have reached a place where science, and the research which has discovered and released its powers, cannot be regarded as matters of accidental growth and application, but must be consciously related to our social life and well being. What these relations are or may become is now a matter of general public concern. How far ought the Government itself go in conducting or supportng research, in guiding the applications of scientific discoveries, and in what way should its responsibilities along these lines be handled best?

March 19

THE SCIENTIFIC METHOD—A DISCUSSION. A. W. LINDSEY

A man not a scientist may accept methods which are not scientific, and yet be highly scientific in all that he does. A scientist ought naturally to use scientific methods, but he may fall far short of that goal. One of Denison's great scientists, Dr. C. J. Herrick, makes the statement: "As a naturalist, I decline to sell out my most precious birthright—namely, the right to live biologically a whole man (physiologically and psychologically) on a naturalistic basis—for a mess of dialectic pottage." The scientific method can be as personal in its results as this

statement suggests. Yet it is a very ordinary process, as was shown in its development and application to the problems of life.

April 16

BURROWS, BARRACKS, BUNGALOWS, BIG BUILDINGS —WHICH? F. G. DETWEILER and HORACE KING

Recent experiments in workingmen's housing, beginning with the German developments and the garden cities of the English, have issued in a number of new projects under the Public Works Administration. What some of the government architects are doing was presented by illustration and description, with due emphasis upon the underlying principles of modern housing. History is being made rapidly today in the business of sheltering human beings.

April 30

SOME PHYSICAL PROPERTIES OF MUSIC AND SOUND, WITH A DEMONSTRATION. R. H. HOWE

Sound comprises a group of phenomena for the study of which each one of us is equipped with the sense of hearing. The place which this group of phenomena occupies among the other vibratory phenomena of nature was explained, and the frequency and intensity response of the human ear—as well as its limitations as a detector of sound—received attention. What the acoustical engineer has done to better the quality of the modern radio loud speaker, and what changes have been made in the design of talking picture equipment to raise its quality to high fidelity, were discussed. Demonstrations of the effect of the removal of all overtones from the musical notes of the piano, cello and French horn; of the effect of overtones upon the quality of music and speech; and a study of acoustical reflections, were made by means of special phonograph records from the Bell Telephone Laboratories.

May 14

GRASPING, AND THE PROXIMAL-DISTAL CONTROVERSY. CHARLOTTE RICE.

From a general statement indicating the importance of a knowledge of the sequence of development for the educator and parent, a specific case was developed which has met with con-

siderable controversy during the past few years, *viz.*, that of the so-called "proximal-distal progression." Experimental material from the speaker's own research on the grasping reflex was utilized to show that some evidence formerly used as an argument against this type of progression is really an argument for it. Such purely automatic reflexes which appear to be fully developed at birth, on further investigation show themselves to be really in a very immature state. This fact and its significance for the proximal-distal theory of development were brought out in the discussion.

The following numbers of the JOURNAL OF THE SCIENTIFIC LABORATORIES OF DENISON UNIVERSITY were published, viz.:

Vol. XXIX, Articles 2, pp. 107–193, August, 1934.
Silurian Cyrtoconic Cephalopods from Ohio, Ontario, and other Areas; Aug. F. Foerste. 86 pp., 14 plates.
Vol. XXIX, Articles 3–4, pp. 195–238, December, 1934.
Evidence of Ice Action in the Teays Valley, West Virginia; Julian J. Petty. 10 pp., 4 figs.
The Earlier History of the Bulletin of the Scientific Laboratories of Denison University; Aug. F. Foerste. 23 pp.
Vol. XXX, Articles 1–2, pp. 1–118, April, 1935.
Big Horn and Related Cephalopods; Aug. F. Foerste. 96 pp., 22 plates.
New Light Sources for Photographic Purposes; W. E. Forsythe. 22 pp., 7 figs.

In December, 1885, appeared the first number of the BULLETIN OF THE SCIENTIFIC LABORATORIES OF DENISON UNIVERSITY, under the able editorship of Clarence Luther Herrick, but with the assistance of August F. Foerste, at that time a sophomore in Denison University. It is well worthy of notice that the activity of Foerste as an investigator and author has now extended through a period of more than fifty years, and that this publication has had articles from his pen in almost every volume issued from 1885 until 1935. At the present time he is active in pursuing studies at the National Museum, Washington, D. C., and has papers of moment almost ready for the press. Denison University honored itself and Dr. Foerste by conferring upon him the degree of Doctor of Science in 1927. May his zeal and strength continue for years to come!

Respectfully submitted,

W. C. EBAUGH, *Permanent Secretary and Editor*

THE CEPHALOPODS OF THE MAQUOKETA SHALE OF IOWA[1]

AUG. F. FOERSTE

Received November 7, 1935; published January 21, 1936

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From the Maquoketa shale of Iowa 22 species of cephalopods are both described and named on the following pages; 6 others are described but are too imperfectly known to warrant designa-

[1] Published by permission of the Director of the Iowa Geological Survey

tion by name. Of this total of 28 forms, 24 are cited from the Elgin member of the Maquoketa though there is a possibility that a few of these came from the overlying Clermont member. One of these species apparently ranges from the Elgin, through the Clermont, up into the Fort Atkinson member. Along the more southeastern outcrops of the Maquoketa shale in Iowa 3 species occur in the Depauperate zone, which stratigraphically belongs beneath the Elgin member, and 1 species occurs in the Cornulites zone at the top of the Maquoketa.

The Maquoketa shale lies directly over the Fernvale limestone at numerous localities in eastern Missouri and southwestern Illinois, and both formations long have been recognized as of Richmond age.

Unfortunately, none of the species of cephalopods found in the Maquoketa shale is known to be strictly identical with any found in the Richmond of Ohio, Indiana, or Kentucky.

The nearest approach to identity is that shown by *Charactoceras laddi* from the Elgin member of the Maquoketa shale, which is closely related to *Charactoceras baeri* from the Whitewater member of the Richmond of the Ohio area. But the genus *Charactoceras* is known also from the Fernvale member of the Richmond on Little Calumet Creek, 6 miles south of Louisiana, in northeast Missouri, and from the northeast edge of Cape Girardeau in the southeastern part of Missouri. It occurs also in the Fernvale member of the Viola formation in the vicinity of Bromide in southcentral Oklahoma. In Anticosti it occurs in the English Head and Vaureal members of the Richmond. *Deckeroceras clermontense*, on the contrary, is related generically only to *Deckeroceras adaense* Foerste from the Fernvale member of the Viola formation at the Lawrence quarry, 7 miles southwest of Ada, in southcentral Oklahoma.

Deiroceras shideleri from the Maquoketa shale is related generically to *Deiroceras dismukesense* Foerste and Teichert from the Richmond of Sumner county, in north central Tennessee, while the species *Armenoceras clermontense* and *Armenoceras iowense* from the Maquoketa are related generically to *Armenoceras madisonense* Foerste and Teichert from the Saluda division

of the Whitewater member of the Richmond at Madison, Indiana. They are related also to *Armenoceras richardsoni* (Stokes) from the Selkirk member of the Red River formation of southern Manitoba.

The genus *Ephippiorthoceras* is widely distributed in the northern part of North America. One species is known from the Fusispira zone in the Prosser member of the Trenton at Wykoff, Minnesota. Most species, however, are of Richmond age. *Ephippiorthoceras modestum* Troedsson was described from the Cape Calhoun beds at Cape Calhoun, in northwestern Greenland. *Ephippiorthoceras dowlingi* Foerste and Savage was described from the Shamattawa limestone on the Shamattawa River southwest of Hudson Bay. *Ephippiorthoceras formosum* (Billings) and *Ephippiorthoceras sieboldi* (Billings) occur in the Richmond of Anticosti. The genus occurs also in the Fernvale of Jasper, in Newton county, Arkansas, and within the Atoka quadrangle of southeastern Oklahoma. The genus is known also from the Big Horn formation of Wyoming and from the Fremont of central Colorado.

Species of *Cyclendoceras* in which the annulations are relatively numerous are known at present only from the more western areas. *Cyclendoceras whiteavesi* Foerste was described from the lower or Dog Head member of the Red River formation in southern Manitoba, but it occurs apparently also in the upper or Selkirk member. *Cyclendoceras costelliferum* Miller was described from the basal part of the Big Horn formation.

In a general way the affiliations of the Maquoketa shale fauna appear to be more with the faunas of the Mississippi Valley, and thence westward and northward, than with those of Ohio, Indiana and Kentucky.

The study of Maquoketa cephalopods here presented was prepared in 1927 as part of a series to be published by Harry Stephen Ladd under the title: The Stratigraphy and Paleontology of the Maquoketa shale of Iowa. Part I of this series was published by Dr. Ladd in 1929, in vol. 34 of the Iowa Geological Survey. The publication of the present contribution has been unavoidably delayed. Recently Dr. Ladd finished the photog-

raphy of such specimens as had not been photographed by him in earlier years. For this, and, still more, for the opportunity of studying this interesting series of cephalopods, the writer desires to express his appreciation.

1. **Endoceras kayi** new species

Plate XXVIII, Fig. 1

The holotype is 260 mm. long, the uppermost distinct suture of a septum being 45 mm. beneath its top. The specimen is depressed dorsoventrally, chiefly on account of deformation after the death of the animal. In its present condition its lateral diameter enlarges from 79 mm. at its base to an estimated diameter of 93 mm. at a point 150 mm. farther up. At a diameter of 85 mm. there are 7 camerae in a corresponding length. The sutures of the septa are directly transverse except along the median part of the ventral side where they curve slightly downward for a width of 30 to 35 mm. The concavity of the septum at its base equals at least 15 mm. Here the lateral diameter of the siphuncle is 36 mm. As far as can be determined in the present condition of the specimen the siphuncle was 2 or 3 mm. from actual contact with the ventral wall of the conch. The surface of the specimen either was smooth or was so weakly annulated that the presence of the annulations is uncertain. If the faint transverse undulations at the base of the specimen are annulations, then 3 crests occur in a length of 7 mm.

Occurrence: Southwest quarter of section 33, Military township, Winneshiek county, Iowa; from the Vogdesia zone of the Elgin member of the Maquoketa. Named in honor of Prof. G. F. Kay, State Geologist of Iowa. Holotype, Cat. No. 8177; State Univ. of Iowa.

Remarks.—This species is similar to *Endoceras proteiforme* Hall from the Trenton of New York in the relative number of its camerae, but its siphuncle is not as large, since in the latter species the siphuncle equals about half of the diameter of the conch, in some specimens slightly exceeding half the diameter.

Another large specimen was found at the same horizon in Cascade Gulch, in the southwest quarter of section 17, Dover township, Fayette county.

Smaller specimens.—Smaller specimens of similar character range in diameter from 40 to 60 mm. The ratio of the diameter of the siphuncle to that of the conch ranges from 0.40 to 0.44, agreeing in this respect with the type of *Endoceras kayi;* but the number of camerae in a length equal to the diameter of the conch is smaller, varying from 5 to 6. These smaller specimens appear to be merely younger stages of growth of the same species as the larger ones. They occur at the same locality as the holotype and also in the south-central part of Clermont township, in Fayette county, Iowa; probably from the Vogdesia zone of the Elgin member.

2. **Endoceras** sp.

Plate XXXVI, Figs. 2, 3

This specimen consists of a fragment of the siphuncle 48 mm. long, beneath which the spiculum projects for a length of 33 mm. The siphuncle widens from a little over 18 mm. at its base to 19 mm. at its top. No trace of the septal annulations remains, its surface appearing smooth. Near contact with the walls of the siphuncle the spiculum contracts rapidly in an apicad direction. The side assumed to be ventral is faintly angulate along its median part except near its top, where the angulation becomes conspicuous, a depression extending upward on each side of a V-shaped contact area between the top of the spiculum and the siphuncle. The dorsal outline of the spiculum is convex along its lower half.

Occurrence: Bloomfield, Davis county, Iowa; probably from the Elgin member of the Maquoketa. Figured specimen, Cat. No. 8178; State Univ. of Iowa.

3. **Cyclendoceras clermontense** new species

Plate XXXIV, Figs. 3, 2

The holotype is 100 mm. long and consists of part of a phragmacone. It is compressed diagonally, due to distortion after the death of the animal. In its present condition its diameter enlarges from 48 mm. near its base to 53 mm. at 65 mm. farther up. Where the diameter is 50 mm. there are 6 camerae in a length of

41 mm. which is equivalent to 7.5 camerae in a length equal to the diameter of the conch. The sutures of the septa apparently are directly transverse. The concavity of the septum at the base of the specimen is 14 mm. The lateral diameter of the siphuncle here is 21 mm. Its dorsoventral diameter is 20 mm., and its distance from the ventral wall of the conch is scarcely 1 mm. The surface of the shell is conspicuously annulated, 22 annulations occurring in a length of 22 mm. where that is also the diameter of the conch. These annulations are fully 0.5 or 0.6 mm. in height and equal the intervening grooves in width. They are straight but slope downward in a ventrad direction at an angle of 10 degrees with the horizontal.

Occurrence: Clermont, Fayette county, Iowa; probably from the Elgin member, but possibly from the Clermont member of the Maquoketa. Holotype, Cat. No. 8179; State Univ. of Iowa.

Another specimen from the same locality and horizon is 78 mm. long and enlarges in lateral diameter from 25.5 mm. at its base to 33 mm. at a point 50 mm. farther up. At its base the siphuncle is 10 mm. in diameter and is in contact with the ventral wall of the conch, at least at the groove between the annulations. At a lateral diameter of 33 mm. there are 14 annulations in a corresponding length. Paratype, Cat. No. 8180; State Univ. of Iowa.

4. **Cyclendoceras thomasi** new species

Plate XXXIII, Fig. 1

The holotype differs from typical *Cyclendoceras clermontense*, from the same locality and horizon, chiefly in the conspicuously smaller number of its annulations. The latter also appear much less prominent, at least on the cast of the interior of the conch.

This holotype is 140 mm. long. Only its ventral half is preserved. Its lateral diameter increases from 57 mm. at its base to 64 mm. at a point 110 mm. farther up. At a diameter of 60 mm. there are 8 camerae in a corresponding length, forming the lower half of the specimen. At a diameter of 64 mm. the upper half has 7 camerae in a corresponding length. The sutures of the septa are directly transverse, except along the median part of the ventral side where for a width of 27 mm. they curve faintly

downward. The concavity of the septum at its base equals about 15 mm. Here the lateral diameter of the siphuncle is 26 mm., and its distance from the ventral wall of the conch apparently is only about half a millimeter at the grooves between the annulations. Along the lower part of the specimen the crests of 7 annulations occur in a length of 30 mm. Along its upper part 13 annulations are indicated in a length equal to the lateral diameter. These annulations slope distinctly downward in a ventrad direction. On the cast of the interior of the conch they are scarcely half a millimeter in height.

Occurrence: Root farm, near Clermont, Fayette county, Iowa; probably from the Elgin member of the Maquoketa. Holotype, Cat No. 8181; State Univ. of Iowa.

5. **Cyclendoceras atkinsonense** new species

Plate XXXIII, Fig. 2; Plate XXVII, Fig. 1

This species appears to be intermediate between the two preceding ones. In fact, all three appear to be closely related, differing chiefly in the relative number of their annulations. The smaller one of the two specimens here described as *Cyclendoceras atkinsonense* differs distinctly in this respect from the holotype of *Cyclendoceras clermontense.* This smaller specimen is 120 mm. long, 85 mm. of this length belonging to the living chamber. In its present depressed condition its lateral diameter increases from 45 mm. at its base to 50 mm. at a point 60 mm. farther up. Two camerae at its base have a total length of nearly 14 mm. The septum at its base has a concavity of 13 mm. The siphuncle here is approximately 18 or 19 mm. in diameter, but is not distinctly outlined. Moreover, its distance from the ventral wall is uncertain. At a diameter of 50 mm. there are 15 annulations in a corresponding length. These slope distinctly downward in a direction regarded as ventrad. Holotype, Cat. No. 8182; State Univ. of Iowa.

The larger specimen is 185 mm. long, about 130 mm. of this length belonging to the living chamber. In its present depressed condition its lateral diameter enlarges from 72.5 mm. near its base to 77 mm. at a point 140 mm. farther up. At its lower end 7

camerae occupy a total length of 49 mm., indicating about 10.5 camerae in a length equal to the lateral diameter. Along the upper half of the specimen, where the lateral diameter is 76 mm., there are about 25 annulations in a corresponding length. These slope distinctly downward in a direction regarded as ventrad. Paratype, No. 8183; State Univ. of Iowa.

Occurrence: Both specimens are from the south side of the bridge across Roger creek, east of Fort Atkinson, Winneshiek county, Iowa; from the Vogdesia zone of the Elgin member of the Maquoketa.

Remarks.—The number of specimens at hand is not adequate to determine to what extent the specimens of *Cyclendoceras* within the Elgin member of the Maquoketa vary in the number of camerae and in the number of the annulations at different stages of growth.

6. **Cyclendoceras** sp.

Plate XXXIV, Fig. 1

Among the specimens of *Cyclendoceras* from the Isotelus zone in the lower part of the Elgin member of the Maquoketa in Clayton county, Iowa, is a fragment of an impression in the rock which is 195 mm. long and originally probably was at least 135 mm. wide. This fragment is strongly annulated, 25 annulations occurring in a length of 135 mm. These annulations are slightly over one millimeter in height and are about as wide as the intervening grooves. This fragment was found in Marion township, in the northwest quarter of the southeast quarter of section 19 in Marion township.

A smaller fragment, not preserving the entire width of the conch, was found on the Galena road, half a mile west of Bellevue, in Jackson county, Iowa, between 10 and 15 feet above the base of the Maquoketa. This specimen is 110 mm. long and 80 mm. wide. It apparently includes one of the lateral margins of the conch. Its original width is unknown. Since no trace of the siphuncle is present it is assumed to be part of the dorsal side, the annulations rising on this side. Nineteen annulations are present in a length of 100 mm. These annulations are fully 1 mm. in

height and are about as wide as the intervening grooves. Figured specimen, Cat. No. 8184; State Univ. of Iowa.

Both of these specimens are of interest chiefly because they belong to a division of the genus *Cyclendoceras* in which the annulations are relatively numerous and in which the conchs attain considerable size. They are unknown at present from the typical Richmond of the area east of the Mississippi Valley, but occur in the Big Horn and Red River formations.

7. **Orthoceras sociale** Hall

Plate XXXVI, Figs. 6, 7, 8

Orthoceras sociale Hall in Miller, North Amer. Pal. Foss., 2nd ed., 245 (1877).

Orthoceras sociale Whitfield, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 2, 71, pl. 8, figs. 16–23 (1895).

Conchs enlarging at an apical angle of about 9 degrees; occasionally attaining a diameter of 25 mm., from which it is estimated that their length sometimes reaches 150 mm. Lengths of 100 to 120 mm. are more common. The length of the living chamber usually is about twice the diameter at its base. The number of camerae in a length equal to the diameter of the conch equals about 5.5 at a diameter of 9 mm.; 4.5 to 5 camerae at a diameter of 12 mm.; and about 5 camerae at a diameter of 15 mm. At a diameter of 19 mm. there may be 5.5 camerae. At gerontic stages of growth the uppermost one or two camerae frequently are conspicuously shorter. This stage of growth is reached usually at diameters of 15, 16, or 17 mm. The sutures of the septa usually are directly transverse. When inclined they rise more or less distinctly toward the ventral side of the conch. The conch frequently is slightly depressed dorsoventrally, the dorsoventral diameter equalling 13.5 mm. where the lateral one is 14.5 mm. In a specimen of this dimension the septum has a concavity of 4 mm., the passage of the siphuncle through the septum equals 1 mm. in diameter and its center is located 5.5 mm. from the ventral wall of the conch. At a dorsoventral diameter of 16 mm. the diameter of this passage equals 1.2 mm. In one specimen in which this passage has a diameter of 1.1 mm., the immediately

overlying connecting ring enlarges from 1.5 mm. at its base to 1.9 mm. near its top and then contracts with convex vertical outlines toward the passage through the overlying septum. The shell of the conch is thin, and its inner layers often retain a pearly luster. Its surface is crossed by fine and very inconspicuous transverse lines which usually do not occur at rhythmic intervals as in typical *Geisonoceras*.

Occurrence: Graf, in Dubuque county, Iowa; from the Lower Maquoketa shale, the matrix containing *Diplograptus peosta*, as at the base of the Elgin member of the Maquoketa. Figured specimens, State Univ. of Iowa, Cat. Nos. 8185, 8186, 8187 in the order here figured.

8. **Geisonoceras** (?) **clermontense** new species

Plate XXIX, Fig. 1

The holotype is 190 mm. long and apparently consists of a living chamber to which one or two camerae are attached. Its maximum diameter enlarges from 72.5 mm. at 20 mm. above its base to 82 mm. at a point 125 mm. farther up. There appears to be a suture of a septum directly transverse to the length of the conch at a point 7 mm. above its base, followed by another suture, less distinctly indicated, about 8 mm. farther up. At the break forming its base there is no trace of either the septa or of the siphuncle, hence the precise orientation of the specimen cannot be determined. The surface of the specimen is banded transversely. Along the lower two-fifths of the length of the conch there are 25 bands in a length equal to the diameter of the conch; along its upper half there are 26 bands in a corresponding length. Along most of the conch these bands vary between 3 and 4 mm. in width, but locally there may be 1, 2, or 3 bands as narrow as 1.5 or 2 mm. Usually 10 bands occupy a length of 30 or 32 mm.

Occurrence: Southcentral part of Clermont township, Fayette county, Iowa; found loose, but probably from the Vogdesia zone ofthe Elgin member of the Maquoke ta. Holotype, Cat. No. 8188, State Univ. of Iowa.

Remarks.—In the absence of the siphuncle the generic relationship of this specimen is uncertain. Transverse bands occur not

only in *Geisonoceras*, but also in *Actinoceras*, *Armenoceras*, and numerous other genera. The specimen described here differs from *Armenoceras clermontense* chiefly in its circular cross section, the ventral side of *Armenoceras clermontense* being distinctly flattened.

9. **Ephippiorthoceras laddi** new species

Plate XXXVI, Fig. 1

The holotype is 133 mm. long, its upper part for a length of 40 mm. belonging to the living chamber. Its maximum diameter in its present condition enlarges from 22 mm. at its base to 35 mm. at its top. The diameter at right angles to the latter appears to be slightly less. The number of camerae in a length equal to the maximum diameter of the conch varies from 6.5 camerae at a diameter of 24 mm. to 4.6 camerae at a diameter of 27 mm., and to 3.7 camerae at a diameter of 30 mm. The uppermost camera is only 4 mm. long, that immediately beneath measuring 8 mm., indicating that the conch had attained its gerontic stage of growth. The sutures of the septa curve strongly downward on the sides assumed to be lateral, the downward curvature equalling 2.5 mm. at a dorsoventral diameter of 25 mm. The cast of the interior of the conch is faintly ribbed vertically near its base, 5 ribs occurring in a width of 8 mm.

Occurrence: In Dover township of Fayette county, Iowa, in the southeast quarter of section 25; about 15 feet above the Vogdesia zone of the Elgin member of the Maquoketa. Holotype, Cat. No. 8189; State Univ. of Iowa.

10. **Ephippiorthoceras tenuistriatum** new species

Plate XXXVI, Fig. 10

The specimen here figured is 38 mm. long and enlarges dorsoventrally from 14.5 mm. at its base to 19 mm. at a point 22 mm. farther up. It is slightly compressed laterally. Four camerae occur in a length equal to the dorsoventral diameter of the conch. The sutures of the septa curve downward about 2.5 mm. laterally, but rise fully 1.5 mm. higher at the side assumed to be ventral

than dorsally. At the base of the specimen the passage of the siphuncle through the septum equals 1.1 mm. in diameter, and its center is 6.5 mm. from that side assumed to be ventral and 6 mm. from the dorsal one. Near its base the surface of the shell is minutely striated vertically, 9 striae occurring in a width of 1 mm.

Occurrence: Tete de Mort township, Jackson county, Iowa; near the boundary between sections 13 and 14; from the depauperate zone at the base of the Maquoketa. Holotype, Cat. No. 8190; State Univ. of Iowa.

11. **Polygrammoceras** sp.

Plate XXIX, Fig. 3

The specimen here figured is 22 mm. long, enlarging in diameter from 11 mm. at its base to 12 mm. at its top. The length of the camerae is uncertain. The surface of the shell is closely striated, the striae or raised lines being broader than the intermediate grooves, the number of striae within the circumference of the conch being estimated at approximately 60. The striae are relatively low and broad. There are also traces of transverse lines, much less conspicuous than the vertical ones.

Occurrence: In Springfield township of Winneshiek county, Iowa, in the northwest quarter of section 11; probably from the Elgin member of the Maquoketa. Figured specimen, Cat. No. 8191; State Univ. of Iowa.

12. **Kionoceras thomasi** new species

Plate XXIX, Fig. 4

The holotype is 15.5 mm. long, its diameter enlarging from 4.5 mm. at its base to 6 mm. at a point 12 mm. farther up. The number of camerae in a length equal to the diameter of the conch increases from slightly more than 2 at its base to 2.5 at its top. The number of vertical ribs within its circumference equals 39, and their crests are sharp and narrow. The corresponding ribs on the cast of the interior of the conch are distinct but much less sharply elevated. The shell is very thin.

Occurrence: Batchtown, Calhoun county, Illinois; from the

depauperate zone at the base of the Maquoketa. Holotype, Cat. No. 8192; State Univ. of Iowa.

13. **Kionoceras postvillense** new species

Plate XXVIII, Figs. 2, 3; Plate XXIX, Fig. 5

The holotype is 18 mm. long and enlarges in diameter from 5 mm. at its base to 6.7 mm. at its top. Apparently there are 6 camerae in a length of nearly 17 mm., with possibly a very short camera at its top. The camerae best exposed appear to be about 2.5 or 2.75 mm. long. The sutures of the septa are directly transverse. The concavity of the uppermost septum is 1.5 mm. Here the passage of the siphuncle through the septum is about 0.6 mm. in diameter and its center is 2.25 mm. from the nearest wall of the conch but 4 mm. distant from the most distant part of the opposite wall. There are 30 vertical ribs within the circumference of the conch and these are slightly broader than the intervening grooves. Holotype, Cat. No. 8193; State Univ. of Iowa.

A second specimen from the same locality is 30.5 mm. long and enlarges in diameter from 5.75 mm. at its base to 7.25 mm. at its top. The top has been sectioned vertically to show the narrow siphuncle. At its passage through the septum at the top its diameter is almost 1 mm. The concavity of this septum is 1.5 mm. The location of the siphuncle is 3 mm. from the nearest wall of the conch and 4 mm. from the farther wall. The length of the camerae can not be determined. There are about 27 vertical ribs within the circumference of the conch, and where best preserved these present a narrow acute ridge with wide intervening grooves. Paratype, Cat. No. 8194; State Univ. of Iowa.

A third specimen is 16 mm. long and enlarges in diameter from 6.25 mm. at its base to 7.5 mm. at its top. Three camerae occur in a length of 3.3 mm., indicating 4.5 camerae in a length equal to the diameter of the conch. The surface of the shell is fluted by about 30 vertical ribs, whose crests are low but relatively sharp and conspicuous. The shell is thin, about 0.1 mm. thick, and the cast of the interior of the conch presents similar vertical ribs,

but not as sharply elevated as those on the surface of the shell. Paratype Cat. No. 8195, State Univ. of Iowa.

Occurrence: North of Postville, Allamakee county, Iowa, along primary road no. 51; probably from the upper part of the Elgin beds of the Maquoketa.

14. **Kionoceras tenuitectum** new species

Plate XXIX, Fig. 2

The holotype is a fragment of a phragmacone 8 mm. long, 10 mm. in diameter at its base, enlarging at an apical angle of 8 degrees. Five camerae occur in a length of 11.5 mm., which is equivalent to 4.5 camerae in a length equal to the diameter of the conch at the top of the series counted. The number of vertical ribs within the circumference of the conch is estimated at 48. These ribs are very narrow, but are much less sharply elevated than in *Kionoceras thomasi*. No distinct traces of these ribs are visible on the cast of the interior of the conch though its shell is very thin.

Occurrence: In Tete de Mort township, in Jackson county, Iowa, near the line between sections 13 and 14; in the depauperate zone at the base of the Maquoketa. Holotype, Cat. No. 8196; State Univ. of Iowa.

15. **Spyroceras perroti** (Clarke)

Plate XXXVII, Fig. 7

Orthoceras perroti Clarke, Geol. Minnesota, 3, pt. 2, 785, pl. 54, figs. 4, 5 (1897).

Spyroceras perroti Foerste, Denison Univ. Bull., Jour. Sci. Labs., 27, pl. 15, fig. 5 (1932).

The holotype is 49 mm. long, its maximum diameter enlarging from 24 mm. at its base to 29 mm. at a point 39 mm. farther up. The relative number of camerae is unknown. The concavity of the septum at the top of the specimen is between 4 and 5 mm. The passage of the siphuncle through this septum is 1.75 mm. in diameter and its location is central. The surface of the shell is strongly annulated, these annulations slanting slightly downward

in the direction of the shorter diameter. Nearly 8 annulations occur in a length equal to the longer diameter of the conch. Their crests are 1 mm. in height, are distinctly rounded and are about as wide as the intervening grooves. There are 32 vertical primary ribs alternating with an equal number of secondary ones. Both sets of ribs are sharp and narrow, extending from the surface of the shell like vertical lamellae projecting for a short distance radially outward. These lamellae are taller over the crests of the annulations than along the intervening grooves, the primary ones reaching a maximum of nearly three-fourths of a millimeter on the crests, the secondary ones equalling only slightly more than a fourth of a millimeter. There also are traces of transverse raised lines, about 4 in a length of 1 mm.

Occurrence: Granger, Minnesota; in the Maquoketa, presumably in its Elgin member, where most of the cephalopods of the Maquoketa occur. Holotype, Cat. No. 4128; State Univ. of Minnesota.

16. **Spyroceras calvini** new species

Plate XXXII, Fig. 2

The holotype is 110 mm. long, reduced by pressure to a flat sheet whose width at present enlarges from 20 mm. at its base to 33 mm. at a point 70 mm. farther up. The specimen is crossed by directly transverse annulations which vary in number from 7 along the lower half of the specimen to 8 farther up, in a length equal to the present width of the specimen. The surface of the shell is exposed along the lower half of the specimen, only the impression remaining along its upper half; both surfaces are sharply defined. These surfaces are ornamented by numerous primary and secondary vertical ribs, tertiary raised lines occurring occasionally. Of the primary ribs 14 occur within the width of the specimen, suggesting about 27 within the circumference of the original conch. The secondary ribs alternate with the latter and usually occur singly, though occasionally two occur in the space between two primary ribs. The crests of both the primary and secondary ribs are occupied by 2 sharply raised lines separated by a very narrow but distinct groove. The tertiary raised lines are few in number,

occur at very irregular intervals, and usually are crested by a single line. Sharply raised transverse lines occur at rhythmic intervals, at the rate of 14 or 15 lines within a length of 10 mm. along the upper part of the specimen.

Occurrence: Graf, Dubuque county, Iowa; in the *Diplograptus peosta* zone in the lowest part of the Elgin member of the Maquoketa. Holotype, Cat. No. 8197; State Univ. of Iowa.

Remarks.—This Graf specimen is somewhat similar in general appearance to *Spyroceras chambliense* Foerste (Upper Ordovician Faunas of Ontario and Quebec, Geol. Surv. Canada, Memoir 138, 222, pl. 39, fig. 3; pl. 40, fig. 1 (1924)), but the rate of expansion of its conch is greater, the annulations are more numerous, and the transverse lines are much more conspicuous and occur at greater intervals.

It is similar to *Spyroceras perroti* (Clarke) in the rate of expansion of its conch, and in the relative number of both its annulations and also of its primary and secondary ribs. However, in typical *Spyroceras perroti* these ribs are very conspicuous and project as lamellar expansions from the surface of the shell, especially upon the summit of the annulations, while the vertical ribs of *Spyroceras calvini* are distinctly not lamellar in form.

17. **Spyroceras clermontense** new species

Plate XXVII, Figs. 3, 2

The holotype is 35 mm. long, its maximum diameter enlarging from 12.5 mm. at its base to 16 mm. at a point 30 mm. farther up. Five annulations occur in a length equal to the diameter of the conch. Twenty-two primary vertical ribs occur within the circumference of the conch, alternating with an equal number of distinct secondary ribs, the primary and secondary ribs in turn alternating with an equal number of much less prominent tertiary vertical raised lines. The primary ribs tend to rise abruptly from the surface of the shell in a narrowly alate manner, similar to those of *Spyroceras perroti*, but less prominent. In addition there are distinct transverse raised lines, about 5 in a length of 2 mm. Compared with *Spyroceras perroti* the annulations are relatively much less numerous. Holotype, Cat. No. 8198; State Univ. of Iowa.

A second specimen from the same locality is 15 mm. long, its rate of enlargement being small. It is moderately compressed due to distortion, its maximum diameter at the top being 9 mm., the minimum here being 7 mm. About 5.5 annulations occur in a length equal to the maximum diameter. There are 25 vertical ribs within the circumference of the conch, alternating with an equal number of secondary ribs, both primary and secondary ribs alternating with a tertiary set of raised vertical lines. The primary ribs are narrow, not more than a sixth of a millimeter wide, but they project from the surface of the shell for a distance of one-fourth to one-third of a millimeter. The secondary ribs are narrower and less prominent, and the tertiary raised lines are relatively inconspicuous. If transverse lines are present, these can not be detected in the present condition of the specimen. Paratype, Cat. No. 8199; State Univ. of Iowa.

Occurrence: Clermont, Fayette county, Iowa; probably from the Elgin member, but possibly from the Clermont member of the Maquoketa.

18. **Spyroceras** sp.

Plate XXXVI, Fig. 9

The specimen here figured is 43 mm. long and enlarges in diameter from 21.5 mm. at its base to 27 mm. at a point 31 mm. farther up. The number of camerae in a length equal to the diameter of the conch increases from 4 at its lower end to 4.3 at its top. The sutures of the septa occupy the grooves between the annulations. The latter are fully 1 mm. in height and have rounded crests about 2 mm. wide, narrower than the intervening grooves. Apparently there are traces of minute vertical lines, about 6 or 7 in a width of 1 mm.

Occurrence: Root farm, near Clermont, Fayette county, Iowa: probably from the Elgin member of the Maquoketa. Figured specimen, Cat. No. 8200, State Univ. of Iowa.

Remarks.—In the character of its annulations this species resembles *Spyroceras microlineatum* Foerste, in the Geology of Anticosti by W. H. Twenhofel (Memoir 154, Geol. Surv. Canada, 274, pl. 36, figs. 1, 2; pl. 37, fig. 1 (1928)), but the sutures of its septa are directly transverse.

19. **Deiroceras shideleri** new species

Plate XXXVII, Fig. 5

The holotype is 56 mm. long and at its upper end is 43 mm. in diameter. Its rate of enlargement appears to have been small. There are 4 camerae in a length of 39 mm. The sutures of the septa are directly transverse. The concavity of the septa equals about 10 mm. At its passage through the upper septa the siphuncle is about 4 mm. in diameter. Its center here is 12 mm. from the ventral wall of the conch. The septal necks are about 1 mm. in length, the connecting rings enlarging to 9 mm. at midheight within the camerae. Owing to the excentric location of the siphuncle its segments are oblique in dorsoventral section. The surface of the shell is not distinctly preserved.

Occurrence: East of Bethel school, southwest of Stockton, Illinois; in Cornulites zone. W. H. Shideler, collector

20. **Sactoceras maquoketense** new species

Plate XXXVI, Figs. 4, 5; Plate XXXVII, Fig. 4

The holotype originally was 97 mm. long but at present is broken across and the upper part has been sectioned dorsoventrally in a vertical direction. The lower fragment enlarges from a diameter of 13 mm. near its base to 17.5 mm. at a point 31 mm. farther up. At the top of the specimen, where its former diameter is estimated to have been 28 mm., there are 6 segments of the siphuncle in a corresponding length. Here the siphuncle narrows to about 1.5 mm. at the septal necks and widens to almost 5 mm. at midheight of the camerae, the length of its segments being 5 mm. The center of the siphuncle here is 6 mm. from the ventral wall of the conch. The interior of the siphuncle is filled with calcitic material but there is no evidence of actinoceroid structure. The surface of the shell appears to havebeen smooth.

Occurrence: Clermont, Fayette county, Iowa; probably from the Isotelus zone of the Egin member of the Maquoketa. Holotype, Cat. No. 8201; State Univ. of Iowa.

21. **Armenoceras clermontense** new species

Plate XXXII, Fig. 1

The holotype is 140 mm. long and consists of the ventral half of the phragmacone. Its lateral diameter enlarges from 51 mm. at its base to 68 mm. at a point 90 mm. farther up. The ventral part of its cross section is distinctly flattened, the radius of transverse curvature here being between 80 and 100 mm. for a width of 40 mm. at a point one-third of the length of the conch from its top, while at the ventrolateral angles the radius of transverse curvature is only 25 mm. Although the dorsal half of the conch is not preserved its transverse outline is assumed to have been approximately semicircular. On the ventral side of the conch the sutures of the septa, as far as preserved, are directly transverse. Eight camerae occur in a length equal to the lateral diameter of the conch. The septa are deeply concave, their concavity equalling 2 camerae in depth in that part of the conch preserved. The siphuncle is very close to the ventral wall of the conch, and either is in slight contact with the latter or is only slightly distant. Along the upper part of the conch its diameter equals about 0.42 of the lateral diameter of the conch. The segments of the siphuncle slope downward in a dorsad direction, forming an angle of 80 degrees with the vertical ventral outline of the conch at its lower end, changing to 75 degrees toward its top. The surface of the shell is banded transversely, 10 bands occurring in a length of 37 or 39 mm.

Occurrence: Near Clermont, Fayette county, Iowa; probably from the Elgin member, but possibly from the Clermont member of the Maquoketa. Holotype, Cat. No. 8202; State Univ. of Iowa.

Remarks.—This species is characterized apparently by the flattening of its ventral side.

22. **Armenoceras iowense** new species

Plate XXXIV, Figs. 4, 5

The holotype is 56 mm. long and consists of the siphuncle and the immediately adjacent part of the ventral side of the conch.

Judging from the transverse curvature of this ventral side the original diameter of the conch at the top of the specimen preserved was about 41 mm. Since the diameter of the siphuncle here is 26 mm. this equals 0.63 of the diameter of the conch. At a point 42.5 mm. farther down the diameter of this siphuncle equals 21 mm., indicating an apical angle of 7 degrees. Six camerae occur in a length of 42 mm., judging from the segments of the siphuncle. The septal necks evidently were very short, as in typical *Armenoceras*, but their diameter can not be determined, with accuracy. The surface of the shell is transversely banded 5 bands occurring in a length varying from 5 to 6 mm.

Occurrence: Clermont, Iowa; probably from the Isotelus zone of the Elgin member of the Maquoketa. Holotype, Cat. No. 8203; State Univ. of Iowa.

This specimen obviously is closely related to *Armenoceras clermontense*, but appears to differ from the latter in the larger size of its siphuncle compared with the diameter of the conch. The siphuncle also appears to enlarge more rapidly. Moreover, the ventral side of the conch is more distinctly rounded. These may be features characteristic of earlier stages of growth than those exhibited by the holotype of *Armenoceras clermontense*, but that can not be determined from the specimens at hand.

23. **Actinoceroid,** from Clermont

Plate XXXVI, Figs. 11, 12

The specimen here figured is a fragment of a siphuncle 30 mm. long, curved lengthwise, the radius of curvature of its convex ventral outline being approximately 70 mm. It has been distorted by pressure dorsoventrally. Its lateral diameter enlarges from 10 mm. at the lowest well preserved segment to 15.5 mm. at the segment 18 mm. farther up. At the segment with a lateral diameter of 14 mm., the dorsoventral diameter, in the present state of the siphuncle, is 12.5 mm. At the base of the specimen, where the segments have been weathered, the structure of the interior resembles vertical fluting.

Occurrence: Root farm, near Clermont, Fayette county, Iowa; probably from the Elgin member of the Maquoketa. Figured specimen, Cat. No. 8204; State Univ. of Iowa.

Remarks.—This specimen is of interest chiefly because it indicates the presence of a curved breviconic actinoceroid, nothing similar being known at present from the Richmond at any locality.

24. **Beloitoceras whitneyi** (Hall)

Plate XXXVII, Figs. 1, 2

Cyrtoceras whitneyi Hall, Rept. Superintendent Geol. Surv. Wisconsin, p. 39 (1861).

Cyrtoceras whitneyi Whitfield, Mem. Amer. Mus. Nat. Hist., 1, pt. 2, 65, pl. 9, fig. 5 (1895).

Cyrtorizoceras whitneyi Foerste, Denison Univ. Bull., Jour. Sci. Labs. 23, 189, pl. 42, figs. 5A, B; 6A, B (1928).

The lectotype is 83 mm. long, and includes the lower part of the living chamber of which a length of 17 mm. is preserved; in addition to this, most of the phragmacone is present. Conch curved lengthwise and compressed laterally. The radius of curvature of its convex ventral outline increases from 50 mm. along the lower half of the specimen to 100 mm. along its upper third. The dorsoventral diameter enlarges from 16.3 mm. at its base to 34.5 mm. at its top. The specimen was compressed in its original state, but was flattened still more after the death of the animal, its lateral diameter at present being 21 mm. at the top of the conch. The number of camerae in a length equal to the dorsoventral diameter at the top of the series counted varies from 10.5 at the lower end of the specimen to 9 near its top, when counted along its ventral outline. The sutures of the septa are almost straight laterally but they rise in a ventrad direction at an angle which increases on approaching the top of the phragmacone. At the base of the specimen these sutures form an angle of 5 degrees with a plane at right angles to the curving vertical axis of the conch, this angle increasing to 20 degrees at the top of the phragmacone. The siphuncle is near the ventral wall of the conch, and the basal part of each segment is almost in contact with the latter. The structure of the siphuncle may be scalariform, but this can not be determined without a dorsoventral section of the type. The diameter of the siphuncle at the base of the specimen is 2.3 mm. The cast of the interior of the conch is

ornamented by low vertical ribs numbering about 8 in a width of 10 mm. at mid-length of the lateral sides.

The second one of the specimens included by Hall in his original description of this species is the only one figured by Whitfield in the memoir cited above. It is 32 mm. long and includes the lower part of the living chamber for a length of 15 mm. Its lengthwise curvature is greater than that of the preceding specimen, the radius of curvature of its convex ventral outline being 50 mm. at the top of the phragmacone. Moreover, the conch appears to enlarge more rapidly in a dorsoventral direction. The chief interest in this specimen is due to the retention of distinct transverse striae belonging to the surface of the shell. These striae curve increasingly downward on passing from the dorsal toward the ventral side of the conch, crossing 3 camerae in their course, and indicating the presence of a deep hyponomic sinus along the ventral side of the aperture at former stages of growth.

Occurrence: Little Maquoketa creek, 10 miles west of Dubuque Iowa, in the Maquoketa, presumably from the Elgin member. American Mus. Nat. Hist., Cat. No. 1400.

25. **Beloitoceras** cf. **whitneyi** (Hall)

Plate XXXVII, Fig. 3

The specimen here figured is 65 mm. long and includes the lower part of the living chamber of which a length of 18 mm. is preserved, in addition to the upper part of the phragmacone. The radius of curvature of the convex ventral outline of the conch is 80 mm., except along the living chamber where it changes to 50 mm. The dorsal outline of the conch is only slightly concave, much less than in the type of *Beloitoceras whitneyi*. The dorsoventral diameter enlarges from 28 mm. at the base to 37.5 mm. at the top of the phragmacone and then decreases to 36 mm. at the highest part of the living chamber preserved. Where its dorsoventral diameter is 37.5 mm. its lateral one is 30 mm., contracting to 27.5 mm. at the top of the specimen, The Graf specimen resembles the lectotype in the relative number of its camerae, in the small curvature of the sutures of its septa, and in their

increasing rise in a ventrad direction on approaching the upper part of the phragmacone. The cast of the interior of the conch has similar low vertical ribs, and the upper part of the cast of the interior of each camera is banded in a similar manner.

Occurrence: Graf, Dubuque county, Iowa; from the lower part of the Maquoketa, presumably from the Elgin member of the Maquoketa. Figured specimen, Cat. No. 8205; State Univ. of Iowa.

Remarks.—Compared with typical *Beloitoceras whitneyi* the Graf specimen is larger, is straighter dorsally, and contracts distinctly dorsoventrally along the living chamber. However, both of the type specimens appear distorted, and provisionally the Graf specimen is regarded as identical specifically.

26. **Beloitoceras** (?) **discrepans** new species

Plate XXXVII, Fig. 8

The holotype is about 77 mm. long and consists of a phragmacone and the lower part of the living chamber, but the latter is not clearly outlined. The radius of curvature of its convex ventral outline increases from 25 mm. along the lower third of the specimen to 50 mm. along its middle third, and to 70 mm. along its upper part. The dorsoventral diameter enlarges from 12 mm. at its base to 25 mm. at the top of the phragmacone, the lateral diameter at this top being 20 mm. At the top of the phragmacone 8 camerae occur in a length equal to the dorsoventral diameter, if counted along the ventral outline. The sutures of the septa curve only slightly downward laterally, but rise in a ventrad direction, especially toward the top of the phragmacone. The lower part of the ventral outline of each segment of the siphuncle is almost in contact with the ventral wall of the conch. The septum at the bottom of each segment meets the curving ventral outline of the conch at an angle of about 60 degrees. The ventral outline of each segment is almost straight and diverges from the ventral outline of the conch at an angle of 10 degrees. This produces the scalariform or stair-like appearance seen along the ventral outline of the specimen as here figured.

Occurrence: Fairfield township, in Jackson county, Iowa, in

section 23; from the Cornulites zone at the top of the Maquoketa in the more southeastern areas of exposure in this state. Holotype, Cat. No. 8206; State Univ. of Iowa.

The relatively straight ventral outlines of the segments of the siphuncle in this species distinguish it not only from *Beloitoceras whitneyi* but also from other known species of this genus. From the species named it is distinguished also by its more rapid rate of enlargement dorsoventrally.

27. **Charactoceras laddi** new species

Plate XXXI, Fig. 1; Plate XXX, Figs. 1, 2, 3

The largest specimen is about 150 mm. in diameter across its umbilical area, its length along the umbilical area equalling about 250 mm. The radius of curvature of its convex ventral outline increases from 70 mm. along the phragmacone and the lower part of the living chamber to 100 mm. farther up. The conch is badly distorted, especially along its lower end. In its present condition its dorsoventral diameter enlarges from 38 mm. at this end to 46 mm. at the base of the living chamber, 80 mm. farther up, and to 50 mm. after an additional interval of 120 mm., above which the ventral outline is not preserved distinctly. At this upper point the width of the conch is approximately 65 mm., and the dorsal impressed zone is about 25 mm. wide and 3 mm. deep. The uppermost camera is 9 mm. long ventrally, the preceding one being 11 mm. long, suggesting that the conch had reached its gerontic stage of growth. At a dorsoventral diameter of 43 mm. there are 3.5 camerae in a corresponding length ventrally. The sutures of the septa curve downward moderately on the lateral sides and rise higher ventrally than dorsally. They rise moderately also across the ventral side of the conch. The transverse curvature of the upper part of the living chamber has a radius of curvature of approximately 50 mm., there being no distinct flattening as on the ventral side, as in typical *Charactoceras baeri*.

Occurrence: South of the bridge over Roger creek, east of Fort Atkinson, Iowa; in the Vogdesia zone of the Elgin member of the Maquoketa. Holotype, Cat. No. 8207; State Univ. of Iowa.

A less distorted specimen has a maximum diameter of 112 mm.

across its umbilical area. Its last volution enlarges in diameter dorsoventrally from about 20 mm. at 205 mm. back from the base of the living chamber to 36 mm. at the base of this chamber, and to 45 mm. at a point 110 mm. above this base. At a dorsoventral diameter of 26 mm. there are 2 camerae in a length of 24 mm. At the top of the phragmacone there are 3.5 camerae in a length of 36 mm. Provisionally this specimen is regarded as a younger individual of *Charactoceras laddi*, though the camerae appear relatively shorter. It was found at Dover Mills, Fayette county, Iowa; and probably came from the Elgin member of the Maquoketa. Paratype, Cat. No. 8208; State Univ. of Iowa.

A third specimen is silicified. Originally it may have been as large as the preceding one, but at present the upper part of the last volution is represented only by that part of its dorsal side which still adheres to the ventral side of the preceding volution. In its present condition the maximum diameter across its umbilical area equals only 86 mm. Immediately above the well preserved part of the phragmacone the sutures of the septa curve conspicuously downward within the dorsal impressed zone, the latter being at least 20 mm. wide. Immediately exterior to the angles of involution the elevated striae on the surface of the shell are directly transverse, but laterally they curve increasingly downward, forming deep and broad ventral sinuses which outline the margin of the hyponomic sinus at former stages of growth. These transverse lines are distinct even where the lateral diameter of the conch scarcely equals 10 mm., but at all stages of growth of the conch they are relatively low and broad, the sharpness of definition of the striae on the lateral sides of the silicified specimen being due in part to weathering. From Postville railroad junction, in Fayette county, Iowa, 3 miles southwest of Postville; from the upper part of the Elgin member of the Maquoketa. Paratype, Cat. No. 8209; State Univ. of Iowa.

These three specimens are assumed to belong to the same species. Unfortunately sufficient distortion has taken place, especially in the direction of lateral compression, to make exact comparison impossible. The last two were recorded as *Charactoceras baeri* in the list prepared for Ladd in 1928.

In typical *Charactoceras baeri* the conch is distinctly flattened along the upper part of the last volution of the conch. This flattening results in ventrolateral angulation, the lateral sides converging in a dorsad direction.

28. **Deckeroceras clermontense** new species

Plate XXXV, Figs. 2, 3, 1

Deckeroceras sp. Foerste, Denison Univ. Bull., Jour. Sci. Labs., 30, 94, pl. 21, fig. 5 (1935).

The holotype, already partially figured in the publication cited above, is 104 mm. long, about 75 mm. of this length belonging to the living chamber. The radius of curvature of its convex ventral outline is 70 mm. along its living chamber, the top of the phragmacone apparently being displaced. The specimen is slightly distorted. In its present condition its dorsoventral diameter at midlength of the living chamber is 46 mm., the lateral diameter here being 49 mm. At the top of this chamber its dorsoventral diameter at present is 40 mm., but this may be due in part to distortion after the death of the animal. Only two camerae are preserved, the lower one being 11 mm. long where in contact with the siphuncle and the upper one having a length of 4 mm. at this point, thus indicating that the conch had reached its gerontic stage of growth. The sutures of the septa apparently curve slightly downward laterally. The concavity of these septa equals 13 mm. The siphuncle is nearly 4 mm. in diameter at its passage through the septa, its center here being 10 mm. from the ventral wall of the conch. Within the lower camera it enlarges in diameter to 4.5 mm., being almost cylindrical except where approaching the septal necks. The latter apparently are scarcely 1 mm. long. The surface of the cast of the interior of the lower camera is striated vertically, 7 striae occurring in a width of 2 mm. Some of these striae at irregular intervals are more conspicuous. Whether the surface of the shell also was striated vertically is unknown.

Occurrence: South of the bridge over Roger creek, east of Fort Atkinson, Winneshiek county, Iowa; from the Vogdesia zone in the Elgin member of the Maquoketa. Holotype, Cat. No. 8210; State Univ. of Iowa.

A second specimen, 130 mm. long, has a radius of curvature of 80 mm. along its living chamber and the top of the phragmacone. Here the lower part of the phragmacone also has been distorted along its ventral outline. Moreover, the conch has been compressed laterally, after the death of the animal. In its present condition its dorsoventral diameter increases from 51 mm. at the base of the living chamber to 52 mm. at midlength of the latter, and then diminishes to 49 mm. at the aperture. Its lateral diameter near the base of the living chamber is 48.5 mm. There are some traces of cameration at the top of the phragmacone, but the length of the camerae can not be determined with accuracy. The sutures of the septa appear to be almost directly transverse, but curve slightly downward laterally. This specimen is from Springfield township, in Winneshiek county, Iowa, and was found along a road between sections 23 and 24 in that township, in the upper part of the Elgin member of the Maquoketa. Paratype, Cat. No. 8211, State Univ. of Iowa.

Remarks.—In typical *Deckeroceras* the conch is depressed dorsoventrally, the dorsoventral diameter contracting toward the aperture along the upper part of the living chamber. For comparison, a figure of the genotype, *Deckeroceras adaense* Foerste, is presented here on plate XXXVII (fig. 6). This genotype is from the Fernvale formation, 7 miles southwest of Ada, Oklahoma and is in the collection of Prof. Charles E. Decker.

PLATE XXVII

Fig. 1. *Cyclendoceras atkinsonense* Foerste. Lateral view, illuminated to show the annulations on the right side of the specimen. Roger creek, east of Fort Atkinson, Iowa; from the Vogdesia zone of the Elgin member of the Maquoketa formation. Paratype; cat. no. 8183, State Univ. of Iowa. For holotype, see pl. XXXIII, fig. 2.

Fig. 2. *Spyroceras clermontense* Foerste. Lateral view, showing surface ornamentation. Clermont, Iowa; probably from the Elgin member of the Maquoketa formation. Paratype; cat. no. 8199, State University of Iowa.

Fig. 3. *Spyroceras clermontense* Foerste. Lateral view, showing surface ornamentation. Clermont, Iowa; probably from the Elgin member of the Maquoketa formation. Holotype; cat. no. 8198, State Univ. of Iowa.

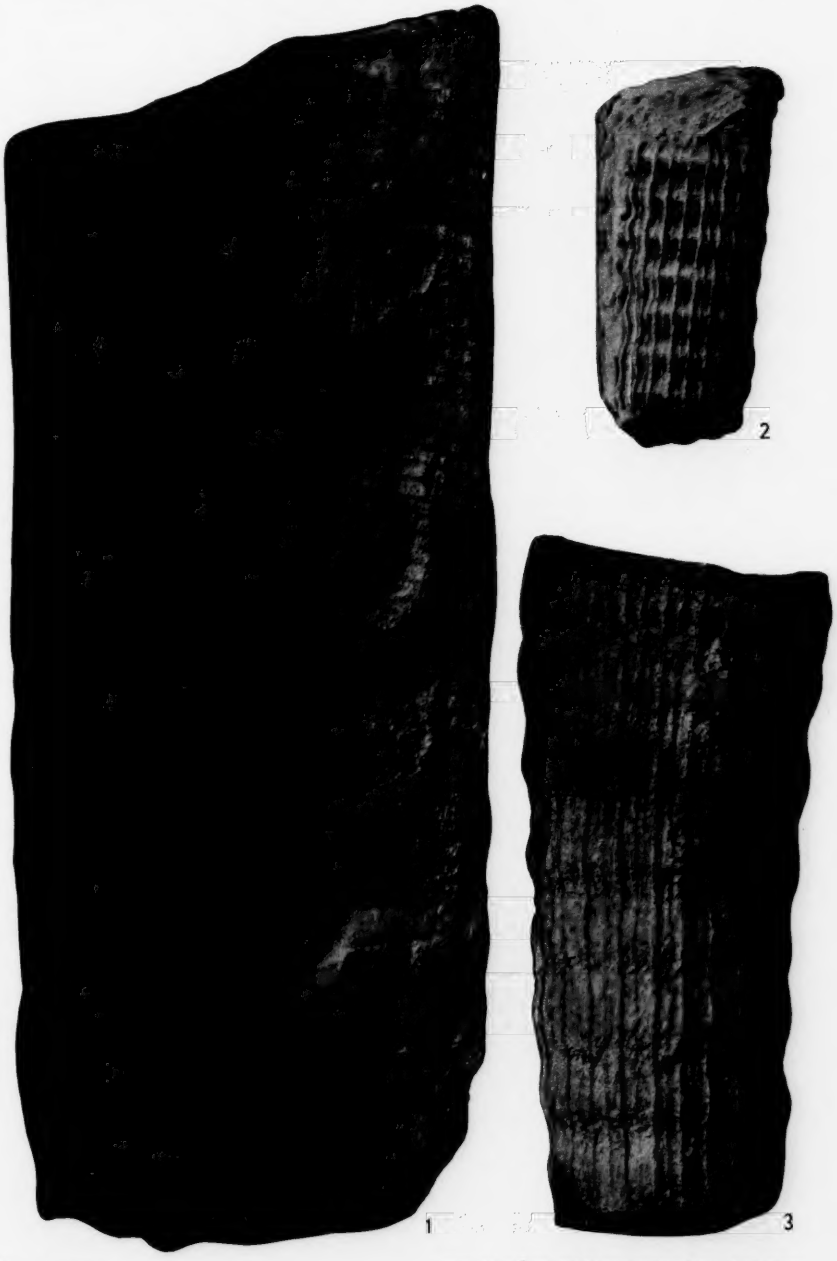

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PLATE XXVIII

Fig. 1. *Endoceras kayi* Foerste. Lower half of specimen, ventral side, with siphuncle at base. Southwest quarter of section 33, Military township, Winneshiek county, Iowa; from the Vogdesia zone of the Elgin member of the Maquoketa formation. Holotype; cat. no. 8177, State Univ. of Iowa.

Fig. 2. *Kionoceras postvillense* Foerste. Lateral view, showing cameration. North of Postville, Iowa; from the upper part of the Elgin beds of the Maquoketa formation. Holotype; cat. no. 8193, State Univ. of Iowa.

Fig. 3. *Kionoceras postvillense* Foerste. Showing only the vertical ribs. From same locality and horizon as the preceding. Paratype; cat. no. 8194, State Univ. of Iowa. For a somewhat similar specimen see pl. XXIX, fig. 5.

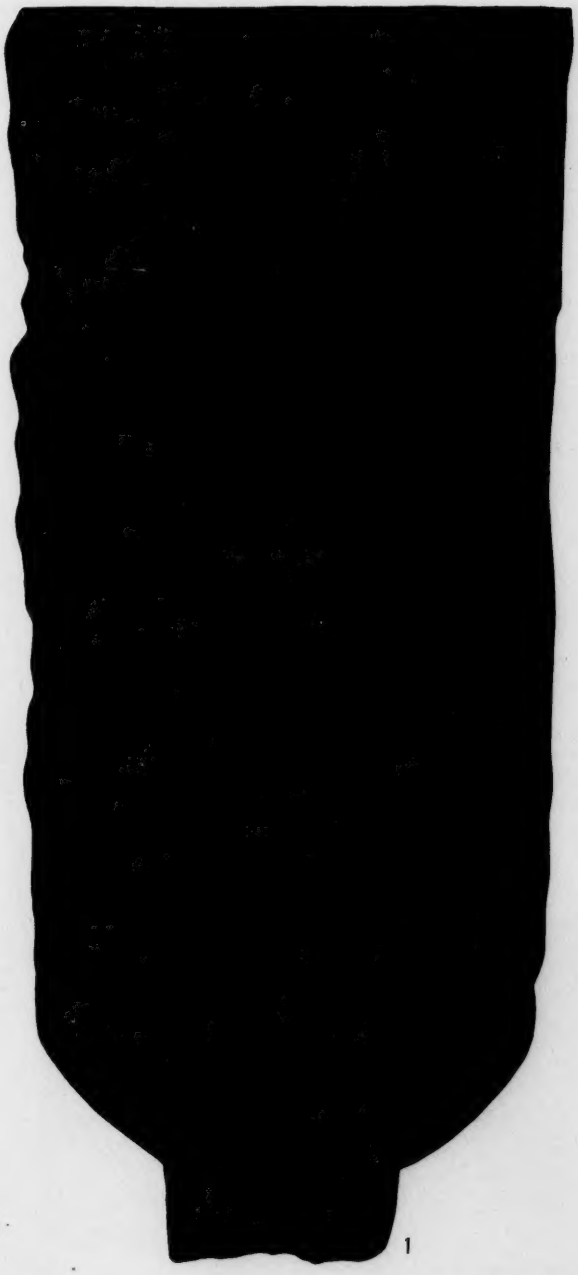

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PLATE XXIX

Fig. 1. *Geisonoceras* (?) *clermontense* Foerste. Lateral view, showing the transverse bands on the surface of the shell; also with traces of cameration at its base. Southcentral part of Clermont township, Fayette county, Iowa; probably from the Vogdesia zone of the Elgin member of the Maquoketa formation. Holotype; cat. no. 8188, State Univ. of Iowa.

Fig. 2. *Kionoceras tenuitectum* Foerste. Lateral view, showing cameration and surface ornamentation. Tete de Mort township, Jackson county, Iowa; from the depauperate zone at the base of the Maquoketa formation. Holotype; cat. no. 8196, State Univ. of Iowa.

Fig. 3. *Polygrammoceras sp.* Lateral view, showing the numerous vertical ribs. Springfield township, Winneshiek county, Iowa; probably from the Elgin member of the Maquoketa formation. Figured specimen; cat. no. 8191, State Univ. of Iowa.

Fig. 4. *Kionoceras thomasi* Foerste. Lateral view, showing both cameration and surface ornamentation. Batchtown, Calhoun county, Iowa. Holotype, cat. no. 8192, State Univ. of Iowa.

Fig. 5. *Kionoceras postvillense* Foerste. Lateral view with surface ornamentation, enlarging more rapidly than typical form. North of Postville, Allamakee county, Iowa; probably from the upper part of the Elgin member of the Maquoketa formation. Paratype; cat. no. 8195, State Univ. of Iowa. For more typical forms, see pl. XXVIII, figs. 2, 3.

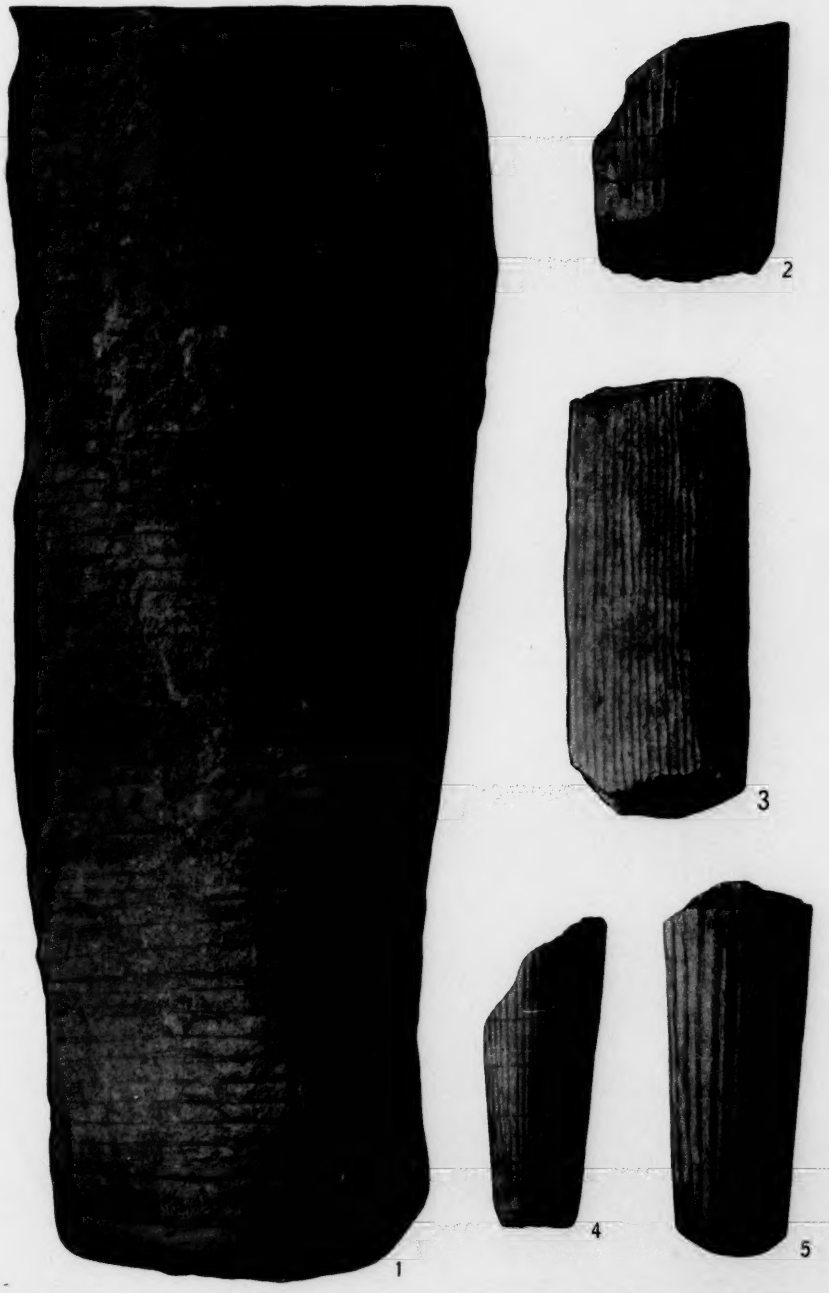

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PLATE XXX

Fig. 1. *Charactoceras laddi* Foerste. Lateral view, showing cameration. Dover Mills, Fayette county, Iowa; probably from the Elgin member of the Maquoketa formation. Paratype; cat. no. 8208, State Univ. of Iowa.

Figs. 2, 3. *Charactoceras laddi* Foerste. Specimen showing surface markings; 2, ventral view; 3, lateral view. Postville railroad junction, Fayette county, Iowa; from the upper part of the Elgin member of the Maquoketa formation. Paratype; cat. no. 8209, State Univ. of Iowa. For holotype see pl. XXXI, fig. 1.

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PLATE XXXI

Fig. 1. *Charactoceras laddi* Foerste. Lateral view, showing cameration. Roger creek, east of Fort Atkinson, Iowa; from the Vogdesia zone of the Elgin member of the Maquoketa formation. Holotype; cat. no. 8207, State Univ. of Iowa. For other specimens see pl. XXX, figs. 1, 2, 3.

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PLATE XXXII

Fig. 1. *Armenoceras clermontense* Foerste. Weathered vertical surface, showing the siphuncle as viewed from the interior of the conch. Clermont, Iowa; probably from the Elgin member of the Maquoketa formation. Holotype; cat. no. 8202, State Univ. of Iowa.

Fig. 2. *Spyroceras calvini* Foerste. Specimen crushed flat. The upper half shows the impression of the surface of the exterior, the vertical grooves representing the vertical ridges; the lower half presents a direct view of the surface of the shell. Graf, Dubuque county, Iowa; in the *Diplograptus peosta* zone in the lowest part of the Elgin member of the Maquoketa formation. Holotype; cat. no. 8197, State Univ. of Iowa.

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PLATE XXXIII

Fig. 1. *Cyclendoceras thomasi* Foerste. Ventral view, illuminated to show the annulations on the surface of the right side. Here they show better on the weathered surface than on the cast of the interior of the conch. Siphuncle exposed along median part of conch. Root farm, near Clermont, Fayette county, Iowa; probably from the Elgin member of the Maquoketa formation. Holotype; cat. no. 8181, State Univ. of Iowa.

Fig. 2. *Cyclendoceras atkinsonense* Foerste. Specimen showing traces of cameration near its base. Roger creek, east of Fort Atkinson, Winneshiek county, Iowa; from the Vogdesia zone of the Elgin member of the Maquoketa formation. Holotype; cat. no. 8182, State Univ. of Iowa.

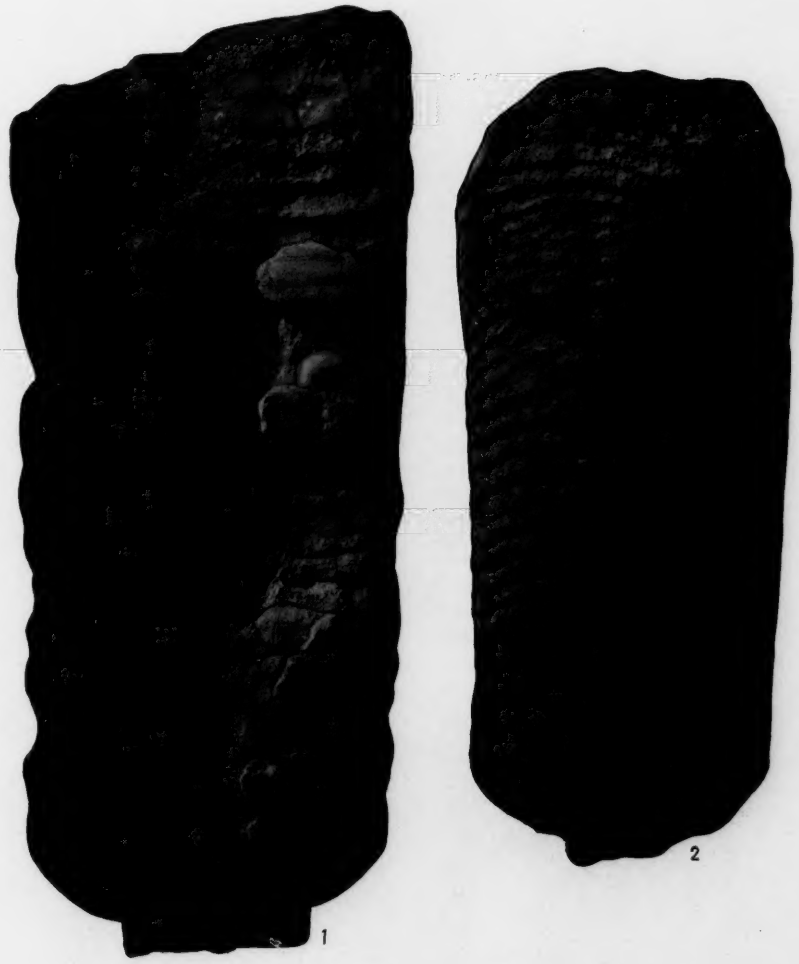
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PLATE XXXIV

Fig. 1. *Cyclendoceras* sp. Specimen showing surface ornamentation, preserving only a part of the width of the conch. A closely similar specimen, mentioned in the text, probably was at least 135 mm. wide. Half a mile west of Bellevue, Jackson county, Iowa, between 10 and 15 feet above the base of the Maquoketa formation. Figured specimen; cat. no. 8184, State Univ. of Iowa.

Fig. 2. *Cyclendoceras clermontense* Foerste. Specimen showing cameration at base. Clermont, Fayette county, Iowa; probably from the Elgin member of the Maquoketa formation. Paratype; cat. no. 8180, State Univ. of Iowa.

Fig. 3. *Cyclendoceras clermontense* Foerste. Specimen showing traces of cameration at top. From same locality and horizon as the preceding. Holotype; cat. no. 8179, State Univ. of Iowa.

Figs. 4, 5. *Armenoceras iowense* Foerste. 4, Ventral view, showing transverse bands, also the lateral outlines of the siphuncle; 5, lateral view, with ventral outline on right. Clermont, Iowa; probably from the Isotelus zone of the Elgin member of the Maquoketa formation. Holotype; cat. no. 8203, State Univ. of Iowa.

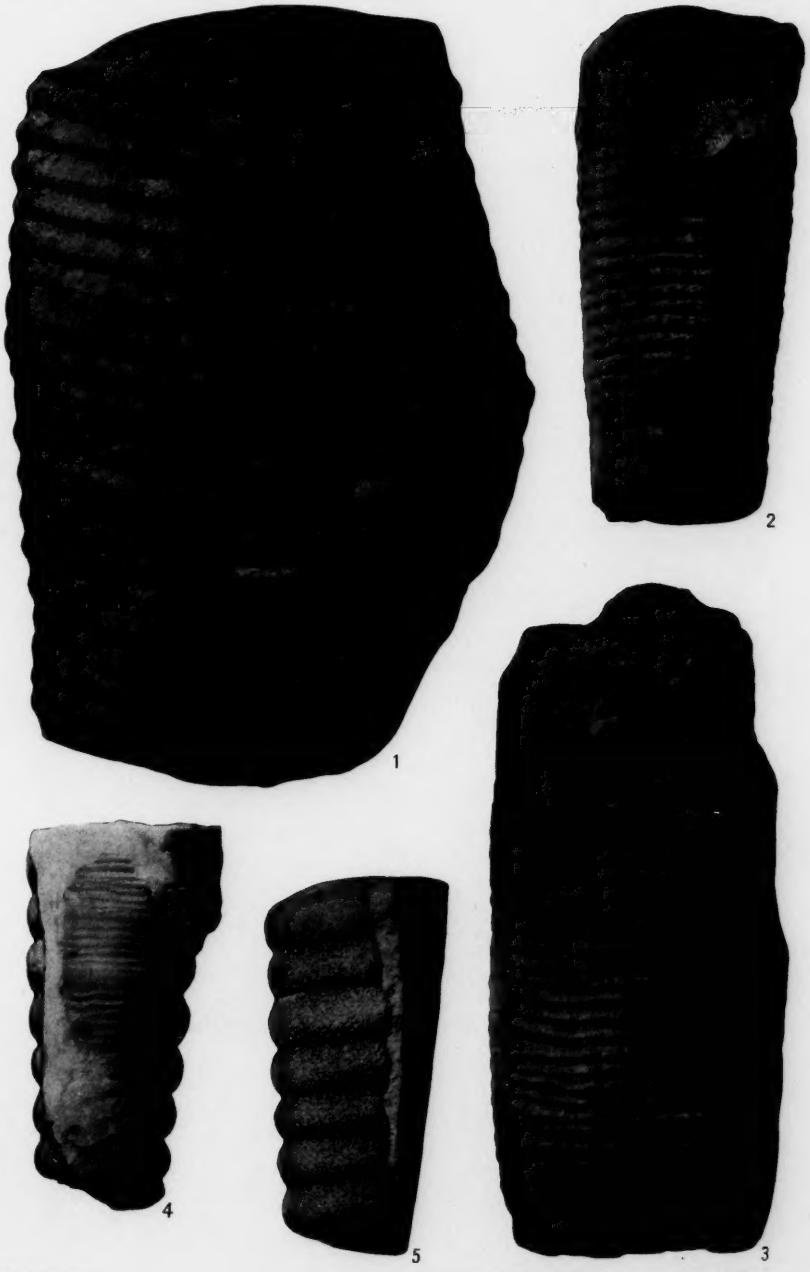

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PLATE XXXV

Fig. 1. *Deckeroceras clermontense* Foerste. Lateral view with ventral outline on left; cameration obscurely shown on opposite side of specimen. Springfield township, Winneshiek county, Iowa; from upper part of Elgin member of the Maquoketa formation. Paratype; cat. no. 8211, State Univ. of Iowa.

Figs. 2, 3. *Deckeroceras clermontense* Foerste. 2, Lateral view, with ventral outline on right; lower part of specimen slightly displaced, but including the two uppermost camerae of the phragmacone. 3, the camerated part, sectioned to show the siphuncle; with ventral outline on right. Holotype, cat. no. 8210, State Univ. of Iowa.

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PLATE XXXVI

Fig. 1. *Ephippiorthoceras laddi* Foerste. Lateral view showing downward curvature of the sutures of the septa. Dover township, Fayette county, Iowa; about 15 feet above the Vogdesia zone of the Elgin member of the Maquoketa formation. Holotype; cat. no. 8189, State Univ. of Iowa.

Figs. 2, 3. *Endoceras* sp. Siphuncle with spiculum projecting downward. 2, view assumed to be ventral; 3, lateral view, the left margin assumed to be ventral. Bloomfield, Davis county, Iowa; probably from the Elgin member of the Maquoketa formation. Figured specimen; cat. no. 8178, State Univ. of Iowa.

Figs. 4, 5. *Sactoceras maquoketense* Foerste. 4, Specimen showing cameration and rate of enlargement of conch at its base, the upper part cut to show the siphuncle. 5, Part of the siphuncle enlarged, the probable course of the septa indicated along its right side. Clermont, Fayette county, Iowa; probably from the Isotelus zone of the Elgin member of the Maquoketa formation. Holotype; cat. no. 8201, State Univ. of Iowa. For cross section see pl. XXXVII, fig. 4.

Figs. 6, 7, 8. *Orthoceras sociale* Hall. 6, Cast of interior of living chamber, showing annular constriction at its top. 7, Another specimen, with short camera at its top suggesting that the conch had reached its gerontic stage of growth. 8, Lower end of another conch. Graf, Dubuque county, Iowa; from the *Diplograptus peosta* zone in the lower part of the Maquoketa formation, probably corresponding to the base of the Elgin member. Figured specimens; cat. numbers 8185, 8186, and 8187, in the order here figures, State Univ. of Iowa.

Fig. 9. *Spyroceras* sp. View showing the prominence of the annulations, also the cameration. Root farm, near Clermont, Fayette county, Iowa; probably from the Elgin member of the Maquoketa. Figured specimen; cat. no. 8200, State Univ. of Iowa.

Fig. 10. *Ephippiorthoceras tenuistriatum* Foerste. Lateral view showing the downward curvature of the sutures of the septa; part of the shell adhering to its lower right. Tete de Mort township, Jackson county, Iowa; from the depauperate zone at the base of the Maquoketa formation. Holotype; cat. no. 8190, State Univ. of Iowa.

Figs. 11, 12. Curved actinoceroid of unknown generic affinities. Siphuncle; 11, Ventral view, slightly oblique; 12, lateral view, with ventral outline on left. Root farm, near Clermont, Fayette county, Iowa; probably from the Elgin member of the Maquoketa formation. Figured specimen; cat. no. 8204, State Univ. of Iowa.

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PLATE XXXVII

Fig. 1. *Beloitoceras whitneyi* (Hall). Phragmacone and basal part of living chamber, with ventral outline on left. Little Maquoketa creek, 10 miles west of Dubuque, Iowa; presumably from the Elgin member of the Maquoketa formation. Lectotype; cat. no. 1400, American Museum of Natural History.

Fig. 2. *Beloitoceras whitneyi* (Hall). Smaller specimen, showing transverse striae. From same locality and horizon as the preceding. Paratype; cat. no. 1400, Am. Mus. Nat. Hist.

Fig. 3. *Beloitoceras* cf. *whitneyi* (Hall). Lateral view, with ventral outline on right; showing faint vertical markings characteristic of the cast of the interior of the conch. Graf, Dubuque county, Iowa; presumably from the Elgin member of the Maquoketa formation. Figured specimen; cat. no. 8205, State Univ. of Iowa.

Fig. 4. *Sactoceras maquoketense* Foerste. Cross section of specimen figured on pl. XXXVI, figs. 4, 5.

Fig. 5. *Deiroceras shideleri* Foerste. Vertical dorsoventral section through the conch showing the siphuncle. The curvature of the right outline is due to weathering. Southwest of Stockton, Illinois; Cornulites zone. Holotype.

Fig. 6. *Deckeroceras adaense* Foerste. Lateral view, with ventral outline on left; the phragmacone sectioned to show the siphuncle in the upper three camerae. Lawrence quarry, 7 miles southwest of Ada, Oklahoma; from the Fernvale formation, immediately over the typical Viola formation. Holotype; collection of Charles E. Decker. See *Remarks*, under *Deckeroceras clermontense* Foerste.

Fig. 7. *Spyroceras perroti* (Clarke). Lateral view showing surface ornamentation. Granger, Minnesota; presumably from the Elgin member of the Maquoketa formation. Holotype; cat. no. 4129, Univ. of Minnesota.

Fig. 8. *Beloitoceras discrepans* Foerste. Lateral view, with ventral outline on left; weathered along its ventral outline so as to show the scalariform outline along the ventral side of the siphuncle. Fairfield township, Jackson county, Iowa; from the Cornulites zone at the top of the Maquoketa formation. Holotype; cat. no. 8206, State Univ. of Iowa.

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NEW GENERA OF OZARKIAN AND CANADIAN CEPHALOPODS

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Plectronoceras Ulrich and Foerste and *Ectenoceras* Ulrich and Foerste belong to a group of genera including also *Sinoeremoceras* Kobayashi and *Wanwanoceras* Kobayashi in which the septal necks curve outward at the brim as in cyrtochoanoidal cephalopods, at least at some stage of development of the conch, even if not continuous throughout. The cyrtochoanoidal structure appears to be connected with the presence of connecting rings which curve outward, into the adjacent camerae, and which appear inflated in vertical sections through the center of the siphuncle. In some of the specimens studied, showing cyrtochoanoidal structure at one stage of development, the septal necks become orthochoanoidal at another stage, showing that the septal necks can change from cyrtochoanoidal to orthochoanoidal within the siphuncle of the same conch. This suggests that even the genus *Multicameroceras* Kobayashi may belong to the same group. For this group Kobayashi has proposed the family name *Plectronoceratidae*. The genotype of *Plectronoceras* was found in the Tsinania zone of the Ch'au-mi-tién limestone of Upper Cambrian age, 25 feet below the top of Pagoda Hill, 1 mile west of Tai-an, in the province of Shan-tung, China. The species *Plectronoceras liaotungense* Kobayashi was found in the same zone at Pai-chia-shan, Wuhutsui basin, Liaotung, South Manchuria. The other genera here mentioned occur in the Wanwankou or Upper Ozarkian division of Wanwanian series in the Niuhsintai basin of South Manchuria.

At present the Plectronoceratidae appear to be an aberrant group, leaving no descendants in later strata either in Asia or in other areas.

In North America the oldest known cephalopods occur in the Ozarkian. The most characteristic of these are the Diphragmidae in which the lower part of the siphuncle is crossed at intervals by transverse diaphragms varying from slightly to deeply concave. These include the endogastric cyrtoconic genera *Burenoceras, Clarkoceras, Conocerina, Dakeoceras, Ectenolites, Eremoceras, Levisoceras, Shelbyoceras,* and *Stemtonoceras;* also the orthoconic genus *Robsonoceras. Albertoceras* probably also belongs here.

The Endoceratidae also make their appearance in the Ozarkian, being represented there by the genera *Ellesmereoceras, Pachendoceras,* and *Walcottoceras.* In the overlying Canadian the Endoceratidae are represented by the orthoconic genera *Catoraphiceras, Clitendoceras, Cotteroceras, Cyptendoceras, Saffordoceras,* and the cyrtoconic endogastric genera *Kirkoceras* and *Mcqueenoceras.*

The Piloceratidae are known at present only from the Canadian, the genera described here being *Allopiloceras* and *Cassinoceras. Mysticoceras* probably also belongs to this family.

Oneotoceras is another characteristic Ozarkian genus, with cyrtoconic, endogastric conchs, but no calcareous deposits have been found so far in the lower part of the siphuncles.

The Canadian is characterized by the presence of numerous exogastric genera. Among the cyrtoconic ones are *Basslerоceras, Dwightoceras, Dyscritoceras, Ectocycloceras, Onychoceras,* and *Seelyoceras.* Among the coiled forms are *Campbelloceras, Centrotarphyceras,* and *Shumardoceras. Amphoroceras* includes gomphoceroid conchs in which the siphuncle is located on the more convex side of the dorsoventral section. *Buttsoceras* is an orthoconic conch with subcentral siphuncle.

Beekmanoceras is one of the very few coiled genera in the Canadian in which the siphuncle is endogastric in location.

These genera are proposed here in the hope that they may be found useful by those working on the Ozarkian and Canadian strata and their faunas.

The genera here selected are chiefly those whose genotypes have already been described and usually figured. A number of

those whose genotypes have hitherto not been described are added. A fuller discussion of variations of structure within the genus, of the geographical and stratigraphical distribution of each genus, and of the species assigned to each genus will be published in a monograph now in process of completion.

ALBERTOCERAS new genus

Conchs small, almost straight, with the ventral outline straight, the dorsal outline slightly convex; enlarging along the phragmacone but contracting slightly along the living chamber. Laterally compressed, about equally rounded both dorsally and ventrally. Camerae short. Sutures of septa curving downward laterally, rising along a straighter course in a ventrad direction, while more concavely curved in a dorsad one. Siphuncle very small, in flattened contact with the ventral wall of the conch. Closely similar to *Ectenolites*, but the conchs are much smaller, they are not concave along the ventral outline; the living chamber is shorter and contracts distinctly toward the aperture; and the siphuncle is much smaller compared with the diameter of the conch.

Genotype: *Albertoceras walcotti* new species. Occurrence: Mons formation, Upper Ozarkian; Alberta, Canada.

Albertoceras walcotti new species

Plate XXXVIII, Figs. 11, 12

The holotype is 11 mm. long, 2 mm. of this length belonging to the base of the living chamber. Dorsal and ventral outlines are straight along the phragmacone, the dorsal one becoming slightly convex along the base of the living chamber. Phragmacone enlarging dorsoventrally from a diameter of 3.8 mm. at its base to 4.8 mm. at its top, the corresponding lateral diameters being 2.8 mm. and 3.1 mm. Six camerae occur in a length equal to the dorsoventral diameter of the conch. The sutures of the septa curve downward laterally the height of one camera, the ventral saddles rising higher than the dorsal ones. At a dorsoventral diameter of the conch of 4.2 mm. that of the siphuncle is 0.3 mm. The siphuncle is circular and is in contact with the ventral wall of the conch.

A living chamber, with a single camera attached, is 5.3 mm. long and narrows from a dorsoventral diameter of 4.5 mm. and a lateral one of 3.9 mm. at its base to 4.0 mm. and 3.5 mm. at its top.

Occurrence: Mons formation, Clearwater canyon, Alberta, Canada. U. S. National Museum, Cat. No. 92682.

ALLOPILOCERAS new genus

Siphuncles curved lengthwise, with the dorsal outline convex. The middle and upper parts of the ventral outline are correspondingly concave, but a short distance below the middle this ventral outline reverses to convex at a point where the lower part of the siphuncle contracts more conspicuously toward the apical end of the siphuncle. Above the point of convexity along the ventral outline the septal annulations show flattened, rhombic contact areas along the median part of their ventral course. Below the point of convexity the lower part of the ventral outline is slightly concave in the genotype, but in some related species this concavity is either inconspicuous or absent. The septal annulations are relatively numerous and slope more strongly downward in a dorsad direction at its base than at the top of the siphuncle.

Genotype: *Allopiloceras tennesseense* new species. Occurrence: Cotter formation, Upper Canadian; Eastern Tennessee.

Allopiloceras tennesseense new species

Plate XXXVIII, Fig. 6

The holotype is a siphuncle 35 mm. long. Its convex dorsal outline has a radius of curvature of 50 mm. Its dorsoventral diameter enlarges from 11 mm. at its base to 21 mm. at a point 18 mm. farther up, and to 24 mm. at its top, both intervals being concave along the ventral outline, the lower interval more deeply concave. The siphuncle is crossed by septal annulations which slope strongly downward in a dorsad direction near the base of the specimen but become more nearly horizontal at its top. In addition, these annulations arch slightly upward laterally. Along the upper interval mentioned above the crests of these annulations form rhombic contact areas, elongated transversely, where

formerly in contact with the ventral wall of the conch. At the top of the specimen there are 4 annulations in a length of 10 mm., the underlying 4 occupying a length of 9 mm. The top of the specimen exposes most of the uppermost endocone, whose original total depth is estimated at 20 mm.

Occurrence: Trundles Cross Roads, near Seymour, Sevier county, Tennessee; in the Cotter formation, Upper Canadian. U. S. National Museum, Cat. No. 92683.

AMPHOROCERAS new genus

Conchs small, erect, slightly depressed dorsoventrally, enlarging rapidly as far as lower third of living chamber and then contracting moderately toward the aperture. The aperture slopes slightly downward in a dorsad direction. There is no hyponomic sinus. The vertical curvature of the ventral outline about equals that of the dorsal one. Camerae short and correspondingly numerous. Sutures of septa directly transverse. Concavity of septa small. Siphuncle very small and located near the ventral wall of the conch, but not in contact with the same. Shell thick, especially along the living chamber. Surface of shell crossed by weak raised lines directly transverse to its vertical axis.

Genotype: *Gomphoceras minimum* Whitfield. Amer. Mus. Nat. Hist., Bull., 1, 321, pl. 27, figs. 3–5 (1886). Occurrence: Fort Cassin formation, Upper Canadian; Vermont.

BASSLEROCERAS new genus

Conchs slightly curved lengthwise, with the ventral outline convex; distinctly compressed laterally, cross section elliptical, with the ventral side slightly more narrowly rounded than the dorsal one. Sutures of septa curving downward laterally, with conspicuous dorsal and ventral saddles, the latter usually being distinctly higher. Siphuncle very small compared with the dorsoventral diameter of the conch, in flattened contact with the ventral wall of the latter, and depressed dorsoventrally in consequence. The segments of the siphuncle present concave vertical outlines along their free sides facing the interior of the conch.

Genotype: *Orthoceras Perseus* Billings. Palaeozoic Fossils,

vol. 1, Geol. Surv. Canada, 313 (1865). Canadian; Philipsburg, province of Quebec, Canada.

BEEKMANOCERAS new genus

Conchs very small, gyroceraconic, consisting approximately of two volutions which diverge from each other at an increasing rate. The living chamber is slightly over half a volution in length. Cross section circular. Camerae relatively long at the smaller end of the conch, becoming shorter farther up. Sutures of the septa apparently curving downward laterally, the septa strongly concave considering the small diameter of the conch. Siphuncle small, located close to the concave outline of the conch, and probably in contact with the latter.

Compared with *Cyrtendoceras* Remele, the conchs of *Beekmanoceras* are much smaller, and are circular in cross section instead of laterally compressed. The siphuncle is relatively much smaller compared with the diameter of the conch.

Genotype: *Cyrtendoceras* (?) *priscum* Ruedemann. New York State Museum Bull., no. 90, 430, pl. 2, figs. 2–5 (1906). Canadian; Beekmantown, New York.

BURENOCERAS Ulrich and Foerste

Burenoceras Ulrich and Foerste. In Geology of the Eminence and Cardareva Quadrangles, by Josiah Bridge. Missouri Bur. Geol. Mines, 2nd ser., 24, 208 (1930).

Conch small, relatively very short, rapidly expanding, more or less strongly curved, moderately compressed laterally, the phragmacone usually somewhat shorter and much smaller than the living chamber, which, as a rule, continues to expand on all sides to the aperture, flaring especially on the ventral side. Camerae shallow, septa very moderately concave, the septal sutures nearly straight and direct or very slightly oblique, the usual dorsal saddles inconspicuous. Siphuncle near or in contact with the ventral wall, its diameter relatively large in the older (Van Buren) species, but always much smaller in their descendants; lower part of siphuncle with one or more flat, transverse diaphragms that correspond to the endocones of other Holochoanities.

Genotype: *Burenoceras pumilum* Ulrich and Foerste, *ibid.*, 208, pl. 20, figs. 32, 33 (1930). Occurrence: Van Buren formation; Missouri.

BUTTSOCERAS Ulrich and Foerste

Buttsoceras Ulrich and Foerste. Science, 78, 288 (1933).

Conchs resembling *Orthoceras* in general appearance. Form straight, sutures of septa directly transverse; siphuncle of moderate size, central in location, and cylindrical in form. Septal necks relatively short with straight vertical outlines. Several of the specimens contain relatively long vertical tubes within the siphuncle. These tubes narrow slowly downward, and in the best preserved specimens are central in position. They narrow more rapidly than the enclosing siphuncle, but it has not been proved that they are not intrusions of some foreign organism. The upper and lower surfaces of the septa are lined with deposits, originally probably calcareous. The deposits of successive camerae are similar in form and are symmetrical with reference to a vertical plane supposed to be dorsoventral in orientation.

Genotype: *Orthoceras* (?) *adamsi* Butts. Geology of Alabama, Geol. Surv. Alabama, special report no. 14, pl. 18, figs. 22, 23 (1926). Odenville formation, Canadian; Alabama.

CAMPBELLOCERAS new genus

Conchs coiled, the volutions in contact with each other but not deeply involuted. Cross section circular or nearly so, dorsal side slightly impressed, if at all, by the preceding volution. Septa only slightly curved downward laterally, and rising only slightly ventrally. The siphuncle is relatively small and is close to the ventral wall of the conch.

In typical *Eurystomites* the conch is more or less compressed laterally, and there is a tendency toward angulation ventrolaterally. The dorsal impressed zone is relatively deep, and the siphuncle of the genotype is relatively larger and farther from the ventral wall of the conch.

Genotype: *Eurystomites virginiana* Hyatt. Amer. Phil. Soc. Proc., 32, 444. Occurrence: Cotter formation, Upper Canadian; Virginia.

CASSINOCERAS new genus

Piloceroids with the ventral outline almost straight, the basal part sometimes slightly convex. The dorsal outline, on the contrary, is conspicuously convex and strongly divergent from the ventral one. The siphuncle usually is distinctly compressed laterally, its cross section being more narrowly rounded ventrally than dorsally.

In typical *Piloceras* the ventral outline of the siphuncle, and evidently also that of the conch, is conspicuously concave along its entire length, and the cross section is more evenly elliptical.

Genotype: *Piloceras explanator* Whitfield. Amer. Mus. Nat. Hist., Bull., 1, 323, pl. 28, figs. 1, 2 (not figs. 3, 4), text fig. on page 325 (1886). Upper Canadian; Vermont and New York.

CATORAPHICERAS new genus

Annulated, orthoconic, holochoanoidal conchs, circular in cross section or slightly depressed dorsoventrally. Camerae relatively short and numerous. Sutures of septa directly transverse dorsally and laterally, but curved strongly and abruptly downward along the median part of the ventral side of the conch, where they form conspicuous, lappet-like, ventral lobes. The siphuncle is near the ventral wall of the conch and may be in contact with the latter, at least in the deeper part of the transverse grooves separating the annulations on the surface of the shell.

Genotype: *Catoraphiceras lobatum* new species. Upper Powell or Smithville formation, Upper Canadian, Wells Creek basin, Western Tennessee.

Catoraphiceras lobatum new species

Plate XXXVIII, Fig. 14

The holotype is 19 mm. long and enlarges very slowly. The lateral diameter at its base is 11.5 mm. Its cross section is circular or slightly depressed dorsoventrally. Its surface is annulated, 5 annulations occurring in a length of 11 mm. The annulations are broadly rounded and are about as wide as the intermediate grooves, rising about half a millimeter above the latter. Ventrally they curve very slightly downward. Six camerae occur in

a length of 11.5 mm. The sutures of the septa are directly transverse dorsally and laterally but curve downward ventrally for a width of 7 mm. and a depth of 1.5 mm., forming lappet-like lobes. The siphuncle is approximately 3.5 mm. in diameter and appears to be in direct contact with the ventral wall of the conch, its structure being holochoanoidal.

Occurrence: Wells Creek Basin, in the southern part of Stewart county, Tennessee; Upper Powell or Smithville formation, Upper Canadian; U. S. National Museum, Cat. No. 92684.

CENTROTARPHYCERAS new genus

Conchs relatively slow in their rate of enlargement, the dorsal side deeply impressed at contact with the preceding volution. Siphuncle subcentral, usually located slightly ventrad of the center of the conch when its dorsoventral diameter is measured from the deepest part of the dorsal impressed zone.

In typical *Tarphyceras* the siphuncle is distinctly nearer the ventral wall of the conch.

Genotype: *Lituites seelyi* Whitfield, Amer. Mus. Nat. Hist., Bull., 1, 330, pl. 31, fig. 2; pl. 32, fig. 3 (1886). Fort Cassin formation, Upper Canadian; Vermont.

CLARKOCERAS Ruedemann

Clarkoceras Ruedemann. New York State Museum Bull., 80, 337 (1905).

Conchs breviconic, laterally compressed, moderately curved lengthwise, the ventral outline concave, the dorsal outline more strongly convex; cross section subovate, more narrowly rounded ventrally than dorsally. Sutures of septa curved downward laterally but rising at an increasing rate toward the dorsal outline so that the dorsal saddles are at a conspicuously higher elevation than the ventral ends of the same sutures. The siphuncle varies greatly in size, but usually is large compared with the dorsoventral diameter of the conch. Its cross section varies from circular to more or less ellipitical, its lateral diameter being shorter; its location is near but not in actual contact with the concave ventral outline of the conch.

Genotype: *Piloceras newton-winchelli* Clarke. Geol. Minnesota, vol. 3, pt. 2, 767, text figures 8, 9; pl. 47, figs. 1–3 (1897). Oneota formation, Upper Ozarkian; Minnesota, Wisconsin, Iowa.

CLITENDOCERAS new genus

Orthoconic holochoanoidal conchs. Cross section nearly circular. Camerae relatively short and numerous. Sutures of the septa nearly straight but sloping from the dorsal side downward in a ventrad direction. Siphuncle very close to the ventral wall of the conch, apparently in contact with the latter.

Genotype: *Clitendoceras saylesi* new species. Fort Cassin formation, Upper Canadian; New York.

Clitendoceras saylesi new species

Plate XXXVIII, Fig. 1

The holotype is 120 mm. long and nearly circular in cross section, its ventral side being slightly flattened. Its lateral diameter enlarges from 16 mm. at its base to 31 mm. at a point 100 mm. farther up. Apparently slightly curved lengthwise, its ventral outline being slightly concave. The number of camerae in a length equal to the lateral diameter of the conch increases from 8 camerae at 18 mm. to 12 camerae at 25 mm., and to 16 camerae at 31 mm. On lateral view the sutures of the septa appear straight, but sloping downward in a ventrad direction at an angle of 10 degrees with the horizontal. The siphuncle is almost in contact with the ventral wall of the conch, its diameter increasing from 5.1 mm. where the diameter of the conch is 19.2 to 7 mm. where the diameter of the latter is 27 mm. Where the diameter of the conch is 20 mm. an endocone is exposed for a length of 8 mm. increasing in diameter within this length from one third of a millimeter to fully 2 mm.

Occurrence: Near Whitehall, Washington county, New York; in the Fort Cassin formation, Upper Canadian. U. S. National Museum, Cat. No. 92685.

CONOCERINA new genus

Conchs small, breviconic, endogastric; enlarging rapidly and continuously, nearly round to distinctly oval in cross section;

very slightly curved, the concavity of the ventral outline barely noticeable on lateral view. Living chamber taking up from two-fifths to one half of the total length. Camerae moderately shallow, the sutures almost directly transverse, the septa not strongly concave. Siphuncle rather small, close to, or in contact with the ventral wall, probably with diaphragms as in *Dakoeceras* and in *Eremoceras*.

Genotype: *Conocerina brevis* new species. Gasconade formation, Upper Ozarkian; Missouri.

Concerina brevis new species

Plate XXXVIII, Fig. 5

The holotype is 11 mm. long, 8 mm. of this length belonging to the living chamber. Its dorsoventral diameter enlarges from 5 mm. at its base to 14 mm. at the top. Laterally the corresponding diameters are 4.5 mm. and 10.5 mm. The ventral outline is faintly concave. Five camerae occur in a length of 2 mm. ventrally, increasing dorsally to a length of 2.6 mm. Septa moderately concave, sutures almost straight or faintly concave when viewed laterally. Siphuncle circular and about 1 mm. in diameter at the base of the living chamber, decreasing to 0.7 mm. at the base of the fifth camera beneath the living chamber; almost in contact with the ventral wall of the conch.

Occurrence: Huzzah Creek, 10 miles east of Steelville, Crawford county, Missouri; Gasconade formation, Upper Ozarkian. U. S. National Museum, Cat. No. 92686.

COTTEROCERAS new genus

The conchs of *Cotteroceras* differ from those of *Clitendoceras* chiefly in the lateral compression of the conch. The sutures of the septa are straight and slant distinctly downward in a ventrad direction. The siphuncle is relatively large and is in contact with the ventral wall of the conch. The endocones are relatively short.

Genotype: *Cotteroceras compressum* new species. Cotter formation, Upper Canadian; Missouri.

Cotteroceras compressum new species

Plate XXXVIII, Fig. 10

The holotype is 75 mm. long, about 45 mm. of this length belonging to the living chamber. Its dorsoventral diameter enlarges from 15.5 mm. at its base to 21 mm. at its top, the corresponding lateral diameters being 13.5 mm. and 17.5 mm. At the base of the living chamber the dorsoventral diameter of the conch is 18 mm. and 18 camerae occur in a corresponding length. On lateral view the sutures of the septa appear straight, but they slope downward in a ventrad direction at an angle of about 10 degrees with the horizontal. The siphuncle is almost in contact with the ventral wall of the conch.

In a paratype 110 mm. long, 70 mm. of this length belongs to the living chamber. Beneath this chamber the siphuncle extends for a length of 40 mm. The dorsoventral diameter of the living chamber is 18 mm. at its base. Here the concavity of the septum at its base is 6 mm., and the dorsoventral diameter of the siphuncle is 7.5 mm., its lateral diameter being very slightly less.

Occurrence: About 3.5 miles northeast of Chadwick, Christian county, Missouri, on the road between Swan and Elkhorn creeks; Cotter formation, Upper Canadian. U. S. National Museum, Cat. No. 92687.

CYPTENDOCERAS new genus

Orthoconic holochoanoidal conchs, with cross sections tending to be slightly flattened ventrally, the dorsoventral diameter usually slightly shorter than the lateral one. Characterized chiefly by the course of the sutures of the septa. These are directly transverse dorsally and laterally but curve distinctly downward ventrally.

Genotype: *Cyptendoceras ruedemanni* new species. Fort Cassin, formation, Upper Canadian; Vermont.

Cyptendoceras ruedemanni new species

Plate XXXVIII, Fig.15

The holotype is 80 mm. long, the basal part of the living chamber being preserved for a length of 5 to 8 mm. Here the lateral

diameter of the conch is 20 mm. while its dorsoventral one is approximately 17 mm., the ventral side being somewhat flattened. At 18 mm. farther down the lateral diameter of the conch is 18.5 mm. Within a length of 15 mm. there are 10 camerae, indicating 12 in a length of 18 mm. The sutures of the septa reach their highest elevation slightly ventrad of the middle of the lateral sides and thence curve downward ventrally, forming broad ventral lobes fully 2 mm. deep. The concavity of the septa equals about 3.5 mm. dorsoventrally. The lateral diameter of the siphuncle is about 6 mm., its ventral side being almost in contact with the adjacent wall of the conch. At a level of 50 mm. beneath the base of the living chamber the black matrix within the siphuncle comes in contact with the whitish calcite filling the basal part of the siphuncle along a diagonal line sloping downward from the ventral toward the dorsal side of the siphuncle at an angle of about 65 degrees with the horizontal. The whitish calcite is regarded as originally an organic deposit, later recrystallized.

Occurrence: Fort Cassin, Vermont; Fort Cassin formation, Upper Canadian. U. S. National Museum, Cat. No. 92688.

DAKEOCERAS Ulrich and Foerste

Dakeoceras Ulrich and Foerste. In Geology of the Eminence and Cardareva Quadrangles, by Josiah Bridge, Missouri Bur. Geol. Mines, 2nd ser., 24, 209 (1930).

Conchs endogastric, moderately breviconic, more or less compressed laterally, curved but mainly in its lower half, usually intermediate in curvature between *Levisoceras* and *Eremoceras*, the rate of enlargement varying from moderate to rapid. Phragmacone usually considerably longer than the living chamber. Camerae shallow, numerous, the sutures, beginning at the ventral outline, curve downward on the lateral sides, the upturn in the dorsal third or half of the conch is more gentle and fails to rise as high dorsally as on the ventral side. Siphuncle usually large, situated close to or in contact with the ventral wall of the conch, its circumference often flattened on the ventral side, with flat diaphragms, apparently at the lower ends of short endocones, in the lower half or two-thirds of the siphuncle.

Genotype: *Dakeoceras normale* Ulrich and Foerste, *ibid.*, 210, pl. 20, fig. 29 (1930). Van Buren formation, Middle Ozarkian; Missouri.

DWIGHTOCERAS new genus

Conch moderately curved lengthwise and slightly compressed laterally. The sutures of the septa curve downward laterally, the dorsal saddles rising a little higher than the ventral ones. The septa curve strongly downward in a dorsoventral direction but only moderately in a lateral one. The siphuncle is in contact with the convex ventral wall of the conch. Its cross section is circular, and not flattened along its area of contact ventrally. Compared with the diameter of the conch, the diameter of the siphuncle is relatively large. No markings are preserved on the surface of the shell.

Genotype: *Cyrtoceras* (?) *dactyloides* Dwight. Amer. Jour. Sci., 3rd ser., 27, 255, pl. 7, figs. 9, 9a (1884). Rochdale formation, Middle Canadian; New York.

DYSCRITOCERAS new genus

Conchs breviconic, curved lengthwise, laterally compressed. Camerae short and relatively numerous. Sutures of the septa curving downward laterally, more closely crowded dorsally than ventrally. Siphuncle small, approximately cylindrical in form, evidently very close to the convex ventral wall of the conch and apparently in contact with the latter.

Genotype: *Cyrtoceras Metellus* Billings. Palaeozoic Fossils, vol. 1, Geol. Surv. Canada, 192, fig. 175 (1865). Canadian; Point Levis, opposite city of Quebec, Canada.

ECTENOLITES new genus

Conchs relatively slender, laterally compressed, enlarging slowly, gently curved along the lower third or half of their length and practically straight along the middle and upper parts. Living chamber usually less than a third of the length of the phragmacone. Camerae shallow and numerous, the sutures more or less curving downward on the lateral sides, the saddles rising

higher ventrally than dorsally. Septa distinctly concave, at least in a dorsoventral direction, and usually also laterally. Siphuncle near or in contact with the slightly concave ventral outline of the conch, varying in diameter from one-eighth to one-fourth of the dorsoventral diameter of the phragmacone, and containing rather long, slowly tapering but truncated endocones. Segments of siphuncle with straight or slightly concave vertical outlines.

Genotype: *Ectenolites subgracile* new species. Gasconade formation, Upper Ozarkian; Missouri.

Formerly both the American species described here under *Ectenolites* and the Asiatic ones described by Kobayashi under *Ectenoceras* were regarded by the writers as belonging to the same genus, namely *Ectenoceras*. However, the segments of the siphuncle of the American species are holochoanoidal and present straight or slightly concave vertical outlines, while those of the Asiatic species are ellipochoanoidal, with the lower margin of the septal necks curving outward in a cyrtochoanoidal manner, at least at certain stages of growth. This led to their generic separation. Since Kobayashi, in connection with his description of three Manchurian species of *Ectenoceras*, naturally cited no species, either American or Asiatic, as genotype of that genus, we select here his *Ectenoceras ruedemanni* as the genotype of *Ectenoceras* as now limited, proposing the new name *Ectenolites* for the American forms, thus keeping the Asiatic species, described first, under their original designation.

Ectenolites subgracile new species

Plate XXXVIII, Figs. 8, 9

The holotype is 31 mm. long, 8 mm. of this length consisting of the living chamber. Part of a single camera is attached to its base, and beneath the latter the siphuncle is exposed for a length of 21 mm., the cast of the exterior of the phragmacone being preserved ventrally and partially also along one of the lateral sides. For a length of 25 mm. the ventral outline has a radius of concave curvature of about 100 mm., this curvature being nearer that of a radius of 50 mm. along the underlying 5 or 6 mm. of this outline.

At the base of the living chamber its lateral diameter is 9 mm. and its dorsoventral one is estimated at 10 mm. The cross section is oval, being distinctly more narrowly rounded dorsally than ventrally. At the top of the phragmacone there are 14 camerae indicated in a length of 10 mm. by the septal annulations on the surface of the siphuncle. The suture of the septum at the base of the living chamber curves distinctly downward laterally. Near its top the siphuncle is 2.3 mm. in lateral diameter and is strongly depressed dorsoventrally. It is very close to the ventral wall of the conch and may have been in contact with the latter.

A paratype is 16 mm. long, 7 mm. of this length belonging to the living chamber laterally, 5 mm. belong to the upper camerae as far as preserved, and the siphuncle is exposed for a length of about 10 mm. beneath the living chamber. The oval cross section of the conch is well shown. The dorsoventral diameter at the base of the living chamber equals 9 mm. Eight camerae occur in a length of 5 mm. or at the rate of nearly 13 in a length of 8 mm. The sutures of the septa curve slightly more than half a millimeter downward laterally and rise about 1 mm. higher ventrally than dorsally, forming subangular ventral saddles, while the dorsal saddles are more rounded. At the base of the conch the dorsoventral diameter of the siphuncle is 1.4 mm. while the lateral one is estimated at 2.5 mm. It evidently is very close to the ventral wall of the conch and may have been in contact with the latter.

Occurrence: On Little Indian Creek, 2.5 miles above its junction with Indian Creek, near the southeastern boundary of Franklin county, Missouri; Gasconade formation, Upper Ozarkian. U. S. National Museum, Cat. No. 92689.

ECTENOCERAS new genus

Conch curved lengthwise, compressed laterally, and apparently breviconic, with the siphuncle located along the concave outline of the conch, apparently in direct contact with the latter. Living chamber distinctly shorter than the phragmacone. Camaerae relatively short. Sutures of the septa curving downward laterally, especially dorsolaterally in the two specimens of the geno-

type figured by Kobayashi. Siphuncle relatively small, and apparently only in narrow contact with the ventral wall of the conch, if at all, while in typical *Ectenolites* the contact area is relatively wider. The septal necks are similar to those of *Plectronoceras*, their lower margins curving strongly outward in a cyrtochoanoidal manner.

Genotype: *Ectenoceras ruedemanni* Kobayashi. Jour. Faculty of Science, Imp. Univ. Tokyo, sec. 2, vol. 3, pt. 7, p. 270, pl. 2, figs. 5, 11. The original of figs. 5a–5d is selected as the holotype of the species. The part 5d has been sectioned dorsoventrally in a vertical direction, showing the structure of the septal necks as here indicated. Wanwankou formation, Upper Ozarkian; South Manchuria. Species published in 1933.

This genus evidently belongs to the new family *Plectronoceratidae* proposed by Kobayashi in 1935, who very kindly permitted the authors to study all of the cephalopod material included by him in this new family. (On the Phylogeny of the primitive nautiloids, with descriptions of *Plectronoceras liaotungense* and *Iddingsia* (?) *shantungensis*, by Teiichi Kobayashi; in Japanese Journal of Geology and Geography, 12, 17–26, pl. 6 (1935).

ECTOCYCLOCERAS new genus

Conchs curved lengthwise; cross section approximately circular but slightly compressed laterally in the genotype. Siphuncle located on the convex ventral side of the conch. Surface of the shell distinctly annulated, and also striated in a direction parallel to the annulations.

Genotype: *Orthoceras Cataline* Billings. Palaeozoic Fossils, vol. 1, Geol. Surv. Canada, 315 (1865). St. Armands formation; Phillipsburg, Canada.

ELLESMEREOCERAS Foerste

Ellesmereoceras Foerste. Denison Univ. Bull., Jour. Sci. Labs., 19, 265 (1921).

Conchs orthoconic, slowly enlarging, laterally compressed. Sutures of septa curving downward laterally, rising almost as high dorsally as ventrally, but a little straighter on approaching

the ventral saddles. Closely similar to *Ectenolites*, but regarded as orthoconic rather than cyrtoconic.

Siphuncle in flattened contact with one of the more narrowly rounded sides of the conch; structure probably holochoanoidal. Differing from *Cotteroceras* chiefly in the downward curvature of the sutures of the septa laterally.

Genotype: *Ellesmereoceras scheii* Foerste. *ibid*, 265, pl. 27, figs. 3 A, B, C; pl. 33, fig. 3 (1921). Ozarkian; Ellesmereland, west of Smith Sound, Artic America.

EREMOCERAS Hyatt

Eremoceras Hyatt, Boston Soc. Nat. Hist., Proc., 22, 282 (1884).
Eremoceras Foerste, Denison Univ. Bull., Jour. Sci. Labs., 19, 263 (1921).

Conchs breviconic, laterally compressed, ventral outline straight or faintly concave, dorsal outline slightly convex along the phragmacone but distinctly convex along the living chamber. Lateral outlines straight along the phragmacone but less divergent along the living chamber. The cast of the interior of the living chamber expands moderately near the aperture, at least along the dorsal half of the conch. Camerae shallow, the septa moderately concave; the sutures of the septa rise moderately laterally, their maximum rise being a short distance dorsad of the center of the conch. On approaching the siphuncle they rise strongly upward, indicating strongly elevated subangular ventral saddles. Siphuncle near the ventral wall of the conch, apparently in flattened contact with the latter, rather large and dorsoventrally compressed in the genotype, but smaller and more rounded in section in other species at present referred to the same genus.

Genotype: *Cyrtoceras Syphax* Billings. Palaeozoic Fossils, vol. 1, Geol. Surv. Canada, p. 194, text-figure 178 (1865). Also Foerste, Denison Univ. Bull, Jour. Sci. Labs., 19, 263, pl. 33, figs. 2, 8 A, B, C (1921). Upper Ozarkian; Point Levis, Canada.

The genotype was found in a massive boulder of limestone in the conglomerates of the Levis shale opposite the city of Quebec, in rocks regarded as of Upper Ozarkian age. In the Geology of Canada, by William Logan, published in 1863, on page 863, it is listed from horizon 4.

KIRKOCERAS new genus

Siphuncles distinctly curved lengthwise, in contact with the concave ventral outline of the conch, the contact area being relatively smooth. Cross section of siphuncles varying from almost circular to distinctly compressed laterally. Both the lateral and the dorsoventral diameters enlarge distinctly along the lower half of the siphuncle and then contract slightly farther up. The siphuncle is obliquely annulated, the crests of these annulations being located along the top of the septal necks and sloping downward from the ventral toward the dorsal side of the siphuncle. These annulations are fairly distinct along the dorsal half of the siphuncle and are more distinct ventrolaterally, but disappear along the area of contact of the siphuncle with the ventral wall of the conch. The interior of the siphuncle was filled with endocones, the filling of the uppermost endocone by matrix forming the spiculum. Where crossing the ventral side of the siphuncle the sutures of the septa curve distinctly downward, no other part of the surface of the conch being preserved.

Genotype: *Kirkoceras arcuatum* new species. Manitou formation, Upper Ozarkian; Colorado.

Kirkoceras arcuatum new species

Plate XXXVIII, Fig. 4

The holotype is 115 mm. long in direct measurement. It consists of a siphuncle with a very small part of the ventral wall of the conch attached to its upper end. Its dorsal outline has a radius of convex curvature of 120 mm. along most of its entire length, this radius being slightly shorter along the lower 10 mm. of its length and slightly longer along its upper 20 mm. The dorsoventral diameter of this siphuncle enlarges from 7.6 mm. at its base to 17 mm. at a point 70 mm. farther up when measured along its dorsal outline, and then decreases to 15 mm. The corresponding lateral diameters are 7.6 mm., 16.6 mm., and approximately 14.4 mm., indicating a practically circular cross section. The septal annulations on the surface of the siphuncle slope downward in a dorsad direction at an angle of about 23 degrees with a

directly transverse plane. Where the maximum diameter of the siphuncle is 17 mm. there are 6 septal annulations in a corresponding length dorsally. Ventrally this siphuncle is in flattened contact with the adjacent wall of the conch for a width of about 7 or 8 mm. at the maximum diameter of this siphuncle. The few traces of the conch attached to the upper end of the ventral side of the siphuncle indicate that here the sutures of the septa curved distinctly downward ventrally.

Occurrence: Williams Canyon, north of Manitou, Colorado; Manitou formation. U. S. National Museum, Cat. No. 92690.

LEVISOCERAS Foerste

Levisoceras Foerste, Denison Univ. Bull., Jour. Sci. Labs., 21, 11 (1925).

Conchs relatively small, strongly curved, concave along the ventral outline, enlarging rapidly along the dorsoventral diameter, laterally compressed, the compression usually increasing toward the aperture. Living chamber shorter than the phragmacone. Camerae relatively shallow and numerous, septa varying from moderately to strongly concave, the concavity increasing with age. Sutures of septa curving downward laterally and rising higher dorsally than ventrally. Siphuncle relatively large, very near or in actual contact with the ventral wall of the conch, and crossed transversely in its lower third or half by flat diaphragms regularly spaced.

Genotype: *Cyrtocerina Mercurius* Billings. Palaeozoic Fossils, vol. 1, Geol. Surv. Canada, p. 194 (1865), not text-figure 179, but the two fragments described in paragraphs two and five, which show the internal structure. Ozarkian; Point Levis, opposite city of Quebec, Canada.

In *Burenoceras* the septa are only slightly concave and the sutures are nearly straight. In *Levisoceras* the septa are rather strongly concave and the sutures are curved downward laterally, the dorsal saddles being longer and reaching higher than the ventral ones. In *Levisoceras* the average size of the conch is considerably greater than in *Burenoceras*, and in most species of *Levisoceras* there is a more or less tendency to lessen the rate of

expansion of the conch on approaching the aperture. In *Burenoceras*, on the contrary, this tendency always is only very slightly expressed or is entirely absent. In *Shelbyoceras* the length of the missing phragmacone is estimated to have been but little more than one-fourth of the total length of the conch, while in *Burenoceras* the phragmacone forms more nearly one-half of the total length. This difference in the relative length of their phragmacones is one of the most distinctive differences between these two genera. *Eremoceras* is distinguished by its more erect and more slowly enlarging conchs.

MCQUEENOCERAS new genus

Conchs relatively short, enlarging rapidly, apparently slightly curved lengthwise, with the ventral outline virtually straight and the dorsal outline only slightly convex; slightly but distinctly compressed laterally. The sutures of the septa are directly transverse dorsally and laterally or slope downward in a ventrad direction at a small angle, but ventrally they curve more conspicuously downward. The camerae are short and numerous. The siphuncle is very close to the ventral wall of the conch and appears to be in actual contact with the latter at least along its median part. The spiculum is in contact with the inner wall of the siphuncle along a diagonal line which is much steeper than the adjacent septa, its ventral face sloping from the median part of the ventral side of the siphuncle downward until its basal tip is within 1 or 2 mm. of the dorsal wall of the latter, the dorsal side of the spiculum being adnate to the dorsal wall of the siphuncle almost as far down as the tip of the spiculum.

Genotype: *Mcqueenoceras jeffersonense* new species. Upper part of Jefferson City formation, Upper Canadian; Missouri.

Mcqueenoceras jeffersonense new species

Plate XXXVIII, Fig. 2

The holotype is 67 mm. long and appears slightly curved lengthwise, with its ventral outline almost straight but apparently with a slight convexity dorsally. Its lateral diameter enlarges from 14 mm. near its base to 23 mm. at a point 50 mm. farther up. At

this upper point its dorsoventral diameter is 26 mm., at least in the present condition of the specimen. Only the phragmacone is preserved. Where the dorsoventral diameter of the conch is 22 mm. there are 15 camerae in a corresponding length ventrally. Where this diameter is estimated at 25 mm. there are 17 mm. in a corresponding length. The sutures of the septa appear to be directly transverse dorsally and laterally, but ventrally they curve strongly downward. Near the top of the specimen, where its circumference is 75 mm., these lobes occupy about 30 mm. in width and 5 mm. in depth. Near the lower end of the specimen, where its lateral diameter is 14 mm., the diameter of the siphuncle is nearly 7 mm. Near its upper end, where its lateral diameter is 23 mm., the diameter of the siphuncle is approximately 12 mm. The siphuncle is circular in cross section and is very close to the ventral wall of the conch, probably in contact with the latter for a width of 3 or 4 mm. along the median part of the siphuncle. That part of the spiculum which faces the ventral side of the conch presents a surface which is distinctly concave in a transverse direction and which inclines at a sharp angle with the ventral outline of the siphuncle from its ventral side toward the dorsal side of the siphuncle.

In a paratype this oblique surface was at least 43 mm. long and terminated at its base in an apical point about 1 mm. in width and apparently less than that from the dorsal wall of the siphuncle. The lateral diameter of the conch at the top of this oblique surface on the ventral side of the spiculum is estimated at 20 mm.

Occurrence: The holotype was found 9 miles south of Mansfield, Missouri, on the road to Ava; the paratype is recorded from 3 miles north of Ava, on the same road; Jefferson City formation, Upper Canadian, U. S. National Museum, Cat. No. 92691.

MYSTICOCERAS new genus

Siphuncles apparently straight, enlarging rapidly at the base and then contracting slightly farther up, both laterally and dorsoventrally, resulting in a slightly bulbous enlargment. The lateral compression is slight. The surface of the siphuncle is crossed by weak septal annulations which are almost straight on lateral view,

sloping downward at an angle of about 30 degrees with the horizontal from the ventral toward the dorsal outline of the siphuncle. The siphuncle appears to have been in narrow vertical contact with the ventral wall of the conch at least along crests of the annulations. On the ventral side of the siphuncle these annulations form angular saddles while they curve evenly across the median part of the dorsal side. A distinct spiculum, vertically ridged as in piloceroids, occurs at the top of that part of the siphuncle preserved.

Genotype: *Mysticoceras vicinum* new species. Hastings Creek formation, Philipsburg sequence; Missisquoi county, province of Quebec.

Mysticoceras vicinum new species

Plate XXXVIII, Fig. 7

Cf. *Orthoceras Marcoui* Barrande. Systême silurien du centre de la Bohême, vol. 2, pt. 3, 748, pl. 431 (1874); pl. 431, figs. 11–13 (1870).

The holotype is a fragment of a siphuncle 60 mm. long. It enlarges from a somewhat pointed apical end to a dorsoventral diameter of 15 mm. at a point about 20 mm. farther up and then contracts about half a millimeter in the following 20 mm. The maximum lateral diameter, at 20 mm. above its apical end, is 14 mm., the original cross section probably having been circular. The number of septal annulations in a length of 15 mm. at the larger diameter of the siphuncle equals 6 when counting from crest to crest. On lateral view they appear straight but they slope downward from the ventral toward the dorsal side of the conch at an angle of 30 degrees with the horizontal. On the median part of the ventral side of the siphuncle these septal annulations forms angular crests. On the median part of its dorsal side they curve evenly downward on dorsal view. The median part of the ventral side of the siphuncle probably was in contact with the ventral wall of the conch.

A paratype similar in form to the lower part of the holotype, is only 37 mm. long. A spiculum, about 15 or 17 mm. long, filled the cavity formed by the upper surface of the uppermost endo-

cone. This spiculum is vertically ribbed at distant intervals around its circumference.

Occurrence: One mile east of Philipsburg, Missisquoi county, province of Quebec, Canada; near the top of the Hastings Creek formation. U. S. National Museum, Cat. No. 92692.

Remarks.—Compared with *Mysticoceras marcoui* (Barrande), cited above, this species differs only in the slightly larger number of its septal annulations in a length equal to the maximum diameter of the siphuncle, and in the smaller slope of these annulations on lateral view. The two species evidently are closely related. They come from the same area and possibly from the same horizon.

ONEOTOCERAS Ulrich

Oneotoceras Ulrich, Geology of Alabama, Geol. Surv. Alabama, Special Rept. No. 14, pl. 15, fig. 8, in description of this plate (1926). Included in section on The Paleozoic Rocks, by Charles Butts.

Conch strongly compressed laterally, more or less strongly curved lengthwise, its ventral outline concave. At varying distances from the apical end of the conch the lateral sides of the phragmacone first flatten and then become broadly grooved longitudinally near their median parts. These longitudinal grooves widen and deepen with the growth of the shell and therefore are developed best along the living chamber of mature conchs, being notable in some specimens only on the latter. Cross sections of the living chamber are shaped somewhat like the figure 8, those of the lower part of the phragmacone being more nearly ovate. Usually the deepest part of the lateral grooves is nearer the dorsal than the ventral outline of the conch. The camerae are shallow and numerous, the septa are strongly concave in a dorsoventral direction, and the sutures of the septa curve downward laterally, often with an angular bend within the lateral groove. The siphuncle is located very close to the ventral wall of the conch. It is relatively large, compressed laterally, and no trace of an endocone or other structure has been found within its interior.

Genotype: *Cyrtoceras loculosum* Hall. Rept. Superintendent of Geol. Surv. Wisconsin, p. 42 (1861); see Whitfield, Amer. Mus. Nat. Hist., Memoir, 1, pt. 2, 67, pl. 9, figs. 6–9 (1895). Oneota formation, Upper Ozarkian; Wisconsin.

ONYCHOCERAS new genus

Conchs moderately curved lengthwise, the ventral outline being convex. Depressed dorsoventrally, the cross section being transversely elliptical, slightly flattened dorsally. The sutures of the septa are nearly straight and slant only slightly downward in a ventral direction. The siphuncle is very small, compared with the diameter of the conch, and is in slight contact with the ventral wall of the latter. Its segments are nearly cylindrical, except at the septal necks which are slightly funnel shaped, the base of each segment invaginating into the top of the neck beneath.

Genotype: *Cyrtoceras confertissimum* Whitfield. Amer. Mus. Nat. Hist., Bull., 1, no. 8, 327, pl. 27, figs. 7–9 (1906). Fort Cassin formation, Upper Canadian; Vermont.

PACHENDOCERAS new genus

Orthoconic holochoanoidal conchs, usually flattened slightly ventrally, resulting in a more or less conspicuous dorsoventral depression of the conch. Camerae short and relatively numerous. Sutures of septa directly transverse, or nearly so, around the entire circumference of the conch. The siphuncle is in contact with the ventral wall of the conch, usually for a more or less conspicuous width.

Genotype: *Cameroceras huzzahense* Ulrich and Foerste. In Geology of the Eminence and Cardareva Quadrangles, by Josiah Bridge. Missouri Bur. Geol. Mines, 2nd ser., 24, 211, pl. 21, fig. 14 (1930). Gasconade formation, Upper Ozarkian; Missouri.

This genus is based not solely on the broad contact of the siphuncle with the ventral wall of the conch, but on the combination of this feature with the straight transverse course of the sutures of the septa across the ventral side of the conch.

PLECTRONOCERAS Ulrich and Foerste

Plectronoceras Ulrich and Foerste. Science, 78, 288 (1933).

Conchs very small, laterally compressed, curved lengthwise, with the siphuncle located on the concave ventral side of the conch. The camerae curve downward laterally, forming dorsal and ventral saddles of approximately the same elevation. The septa are moderately concave, their concavity being most conspicuous in a dorsoventral direction. The siphuncle is very small compared with the dorsoventral diameter of the conch.

In a specimen sectioned by Teiichi Kobayashi in a dorsoventral vertical direction, belonging to his species *Plectronoceras liaotungense*, the septal necks on that side of the siphuncle facing the interior of the conch are recurved at their lower margin, as in typical forms of Cyrtochoanites. The second camera from the top preserves one of the connecting rings which, in vertical section, presents an inflated, bulbous appearance, similar to those characteristic of his genus *Sinoeremoceras* and the species described by him under *Ectenoceras curvatum*.

Genotype: *Cyrtoceras cambria* Walcott, in Research in China, published by the Carnegie Institution of Washington, vol. 3, p. 98, pl. 98, figs. 4, 4a-c (1913). From Tsinania zone, upper half of Ch'au-mi-tién limestone, Upper Cambrian; Tsi-nan, Shantung, northeastern China.

PROTOCYCLOCERAS Hyatt

Protocycloceras Hyatt. Zittel-Eastman, Text-book of Paleontology, vol. 1, 518 (1900).

Conchs, straight, surface annulated; annulations directly transverse or rising slightly in a dorsad direction. Camerae about as numerous as the annulations, but their number not strictly identical. Sutures of septa parallel to the annulations. Septa of moderate depth. Siphuncle located nearer the ventral side of the conch than its distance from the dorsal one, but not near contact with the former. The lower part of the siphuncle is filled with calcareous deposits whose upper surface is formed by a transverse lamella which slopes steeply downward from the ventral toward the dorsal side of the siphuncle, its median part

arching slightly in a convex manner toward this dorsal side. In consequence the spiculum or indurated matrix which fills the upper part of the siphuncle, above this oblique lamella, has a long wedge-shaped form whose ventral face is concavely grooved medially. The surface of the shell in some species appears smooth and in others is striated transversely.

Genotype: *Orthoceras lamarcki* Billings. Canadian Nat. Geol., 4, 362, text-fig. 11 on page 361, figs. f, g, h (1859). Also Palaeozoic Fossils, vol. 1, Geol. Surv. Canada, 347, text-fig. 336 (1865). Upper Canadian, Mingan islands, and southeastern Ontario, Canada.

Remarks.—The peculiar diagonal surface at the top of the calcitic deposits in the lower part of the siphuncle is characteristic not only of the genotype but also of the almost identical species described by Salter from the Durness limestone of northwestern Scotland under the name *Orthoceras mendax*.

ROBSONOCERAS Ulrich and Foerste

Robsonoceras Ulrich and Foerste. Science, 78, 288 (1933).

Conchs relatively small, usually in fragments only 20 to 30 mm. long, their maximum diameter usually only 6 or 7 mm.; orthoconic, slowly expanding. Camerae shallow, sutures of septa straight and directly transverse, septa rather strongly concave. Siphuncle small, with straight vertical walls, almost in contact with the ventral wall of the conch. The lower part of the interior of the siphuncle is crossed by more or less strongly concave diaphragms, more numerous than the adjacent camerae.

Genotype: *Ellesmereoceras robsonense* Walcott. Mons formation, Upper Ozarkian; British Columbia, Canada. Walcott, Smithsonian Misc. Coll., 67, no. 9, 527, pl. 126, figs. 5, 6, 8, 9 (1924).

SAFFORDOCERAS new genus

Conchs orthoconic, holochoanoidal, with relatively short and numerous camerae. Sutures of septa straight and directly transverse. Siphuncle small compared with the diameter of the conch, very close to the ventral wall of the conch and possibly in actual

contact with the latter. Considering the small diameter of the siphuncle the spiculum filling the cavity formed by the uppermost endocone is relatively slender, approximately circular in cross section, with a slight tendency to vertical angulation.

Compared with typical *Pachendoceras* the conch enlarges more rapidly and the siphuncle is relatively much smaller.

Genotype: *Saffordoceras jeffersonense* new species. Roubidoux formation, Middle Canadian; Tennessee.

Saffordoceras jeffersonense new species

Plate XXXVIII, Fig. 16

The holotype is 50 mm. long. Its cross section is circular. The conch enlarges rather rapidly, its lateral diameter increasing from 10.5 mm. near its base to 18 mm. at a point 26 mm. farther up. There are nearly 14 camerae in a length of 18 mm. where that is the diameter of the conch at the top of the series counted. The sutures of the septa are directly transverse, ventrally as well as laterally. The siphuncle is very close to the ventral wall of the conch though apparently not in actual contact with the latter. Where the diameter of the conch is 16.5 mm. that of the siphuncle is 2.5 mm. At a diameter of the conch of 18 mm. the top of a spiculum is located. It is preserved for a length of 6 mm. and its original length is estimated at about 8 mm., the diameter of the siphuncle being approximately 3.5 mm.

Occurrence: One mile southwest of Jefferson City, Tennessee; Roubidoux formation, Middle Canadian. U. S. National Museum, Cat. No. 92693.

SEELYOCERAS new genus

Conch strongly curved lengthwise, depressed dorsoventrally. The sutures of the septa curve downward laterally, the resulting ventral saddles being obtusely angular. Siphuncle relatively small, in contact with the ventral wall of the conch. Surface of shell faintly annulated ventrally, the annulations becoming obsolete laterally. As far as their course can be traced these annulations are relatively straight and directly transverse.

Genotype: *Cyrtoceras raei* Whitfield. Amer. Mus. Nat. Hist.,

Bull., 2, no. 2, 58, pl. 10, figs. 8, 9 (1889). Beekmantown formation, Canadian; New York.

SHELBYOCERAS Ulrich and Foerste

Shelbyoceras Ulrich and Foerste. In Geology of the Eminence and Cardareva Quadrangles, by Josiah Bridge. Missouri Bur. Geol. Mines, 2nd ser., 24, 207 (1930).

Conchs strongly compressed laterally, slightly curved lengthwise, the slightly convex side being assumed to be dorsal. The cross section enlarges rapidly in a dorsoventral direction, angulate dorsally. Living chamber very large and much longer than the phragmacone. Only the septum at the base of this chamber is known and this is strongly concave in a dorsoventral direction, the sutures curving downward laterally.

Shelbyoceras is distinguished from related genera by its relatively very large living chamber, compared with the much shorter phragmacone, and also by its erect form.

Genotype: *Shelbyoceras robustum* new species. Eminence formation, Lower Ozarkian; Missouri.

Shelbyoceras robustum new species

Plate XXXVIII, Fig. 13

Holotype consisting only of a living chamber at present 25 mm. long, but originally several millimeters longer. Its dorsal outline has a radius of convex curvature of about 60 mm. Its ventral outline is correspondingly concave. Its dorsoventral diameter increases from 14 mm. at its base to approximately 31 mm. at a point about 23 mm. farther up. The corresponding lateral diameters are 10.5 mm. and approximately 22.5 mm. The cross section of this living chamber is oval, the dorsal side being distinctly more narrowly rounded than the ventral one. The original length of the phragmacone is estimated at 14 or 15 mm. along its vertical axis, or about half the length of the living chamber. The suture of the septum at the base of this chamber curves very slightly downward laterally, the concavity of this septum equalling fully 2 mm. No trace of the siphuncle remains but the latter is assumed to have been located close to the concave

vertical outline of the conch, here called ventral. The specimen is a cast of the interior of the living chamber, and the surface of this cast is marked by several relatively distant vertical raised lines of slight elevation.

Occurrence: Four miles south of Eminence, Shannon county, Missouri, near the Munsell school; in the Eminence formation, Lower Ozarkian. U. S. National Museum, Cat. No. 92694.

SHUMARDOCERAS new genus

Conchs small, about two and a half volutions long. The volutions are in contact with each other along the phragmacone and the lower part of the living chamber, but become free along the upper half of this chamber. There is no impressed zone along the dorsal side of these volutions. Cross section oval, strongly compressed laterally, the ventral side more narrowly rounded. Sutures of septa curving downward laterally, rising into conspicuous saddles ventrally, but elevated only slightly dorsally. Siphuncle very small, located about as far from the convex ventral outline of the conch as its own diameter. Segments of siphuncle narrowly cylindrical.

Genotype: *Lituites complanata* Shumard. St. Louis Acad. Sci., Trans., 2, 107 (1863). Jefferson City formation; Upper Canadian; Missouri.

STEMTONOCERAS new genus

Conchs slowly enlarging, slender, moderately curved lengthwise, the ventral side being along the concave outline. Camerae short and numerous. Sutures of the septa curving downward laterally, the ventral saddles not defined distinctly but apparently broadly rounded, instead of distinctly angular. Siphuncle located very close to the ventral wall of the conch, apparently in broad contact with the latter; dorsoventrally depressed, its dorsoventral diameter equalling about one-fourth of that of the conch. Its lower part occupied by transverse concave diaphragms, located at somewhat unequal intervals.

Genotype: *Stemtonoceras elongatum* new species. Upper Ozarkian; Pennsylvania.

Stemtonoceras elongatum new species

Plate XXXVIII, Fig. 3

The holotype is 80 mm. long, its convex dorsal outline having a radius of curvature of 110 mm. Its dorsoventral diameter enlarges from 17 mm. near its base to 23.5 mm. at a point 70 mm. farther up dorsally. The corresponding lateral diameters are 14.5 mm. and 20.5 mm. The camerae can be detected only between 8 and 20 mm. above the base of the specimen where the dorsoventral diameters of the conch range between 17.5 and 18 mm. Here there are 10 camerae in a length of 10 mm. The sutures curve downward laterally at least 1 mm., forming dorsal and ventral saddles. Where the dorsoventral diameter of the conch is 18 mm. that of the siphuncle is 4.5 mm., its lateral diameter being 5.3 mm. The siphuncle is in broad contact with the ventral wall of the conch, apparently for a width of 4.5 mm. At the base of the specimen the dorsoventral diameter of the siphuncle is 3.3 mm. Here a dorsoventral vertical section through the center of the siphuncle exposes 5 concave diaphragms in a length of 5 mm. These are arranged at somewhat irregular intervals, the lowest diaphragm being 2 mm. above the base of the specimen. The surface of the specimen is weathered but apparently it was relatively smooth.

Occurrence: At the quarry southeast of Stemton, 4.5 miles north of Allentown, in eastern Pennsylvania; Upper Ozarkian. U. S. National Museum, Cat. No. 92695.

WALCOTTOCERAS new genus

Conchs orthoconic, holochoanoidal; compressed laterally, and distinctly annulated; usually small. The phragmacone enlarges slowly and in some species is distinctly curved, with the siphuncle very near its concave outline, but the living chamber is relatively long and straight. The camerae are relatively short. The sutures of the septa curve distinctly downward laterally, leaving conspicuous ventral and dorsal saddles. Siphuncle small, almost or actually in contact with the ventral wall of the conch in the deeper part of the transverse grooves between the annulations.

Genotype: *Endoceras* ? *monsensis* Walcott. Smithsonian Misc. Coll., 67, no. 9, 529, pl. 126, figs. 4, 4a, 4b (1923). Mons formation, Upper Ozarkian; Alberta, western Canada.

PLATE XXXVIII

Fig. 1. *Clitendoceras saylesi* Ulrich and Foerste. Lateral view of upper part of specimen with ventral outline on right, showing downward slant of sutures of septa in a ventrad direction. Near Whitehall, Washington county, New York; from the Fort Cassin formation, Upper Canadian. Holotype; cat. no. 92685, U. S. National Museum.

Fig. 2. *Mcqueenoceras jeffersonense* Ulrich and Foerste. Lateral view showing slight convex curvature of dorsal outline on right side of conch. Sutures of septa approximately horizontal laterally, curving strongly downward in a ventrad direction. South of Mansfield 9 miles, on the road to Ava, in Douglas county, Missouri; upper part of Jefferson City formation, Upper Canadian. Holotype; cat. no. 92691, U. S. National Museum.

Fig. 3. *Stemtonoceras elongatum* Ulrich and Foerste. Lateral view with ventral outline on right; lower part showing cameration and siphuncle, the latter containing transverse concave diaphragms. Quarry southeast of Stemton, 4.5 miles north of Allentown, Pennsylvania; in the Upper Ozarkian. Holotype; cat. no. 92695, U. S. National Museum.

Fig. 4. *Kirkoceras arcuatum* Ulrich and Foerste. Siphuncle with ventral outline on right, showing septal annulations sloping downward in a dorsad direction. From the vicinity of Manitou, Colorado, probably from Williams canyon; in the Upper Ozarkian. Holotype; cat. no. 92690, U. S. National Museum.

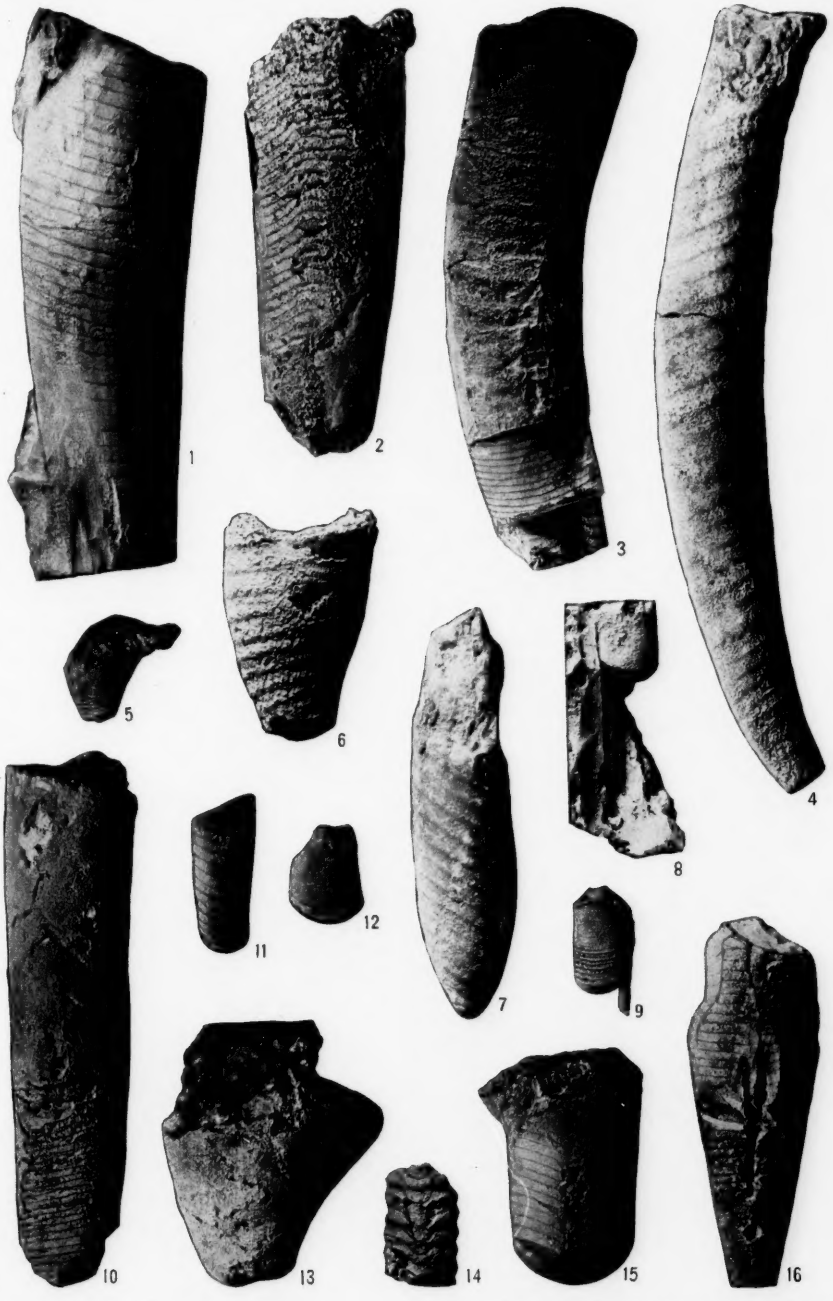
Fig. 5. *Conocerina brevis* Ulrich and Foerste. Lateral view with ventral outline on right, showing short phragmacone and very shallow camerae. East of Steelville, Missouri, 10 miles, on Huzzah creek; in the Gasconade formation, Upper Ozarkian. Holotype; cat. no. 92686, U. S. National Museum.

Fig. 6. *Allopiloceras tennesseense* Ulrich and Foerste. Lateral view of siphuncle, with ventral outline on right, showing change in direction of this outline near its midlength. The septal annulations slope downward in a dorsad direction. Trundles Cross Roads, near Seymour, Sevier county, Tennessee; from the Cotter formation, Upper Canadian. Holotype; cat. no. 92683, U. S. National Museum.

Fig. 7. *Mysticoceras vicinum* Ulrich and Foerste. Lateral view of siphuncle, with ventral outline on left, the septal annulations sloping downward in a dorsad direction. East of Philipsburg, Missisquoi county, province of Quebec, Canada; near the top of the Hastings Creek formation, in the Philipsburg series. Holotype; cat. no. 92692, U. S. National Museum.

Fig. 8. *Ectenolites subgracile* Ulrich and Foerste. Lateral view with ventral outline on left; showing living chamber at top and most of the siphuncle beneath the latter. The septal annulations are distinct on the lateral side of the siphuncle opposite to that figured. On Little Indian creek, 2.5 miles above its junction with Indian creek, near the southern boundary of Franklin county, Missouri; from the Gasconade formation, Upper Ozarkian. Holotype; cat. no. 92689a, U. S. National Museum.

(*Continued on reverse of plate*)



E. O. ULRICH AND AUG. F. FOERSTE

OZARKIAN AND CANADIAN CEPHALOPODS

Fig. 9. *Ectenolites subgracile* Ulrich and Foerste. Lateral view of conch with ventral outline on right, showing living chamber, 8 camerae, and siphuncle on right. From the same locality and horizon as the preceding. Paratype, cat. no. 92689b, U. S. National Museum.

Fig. 10. *Cotteroceras compressum* Ulrich and Foerste. Lateral view with ventral outline on left, showing living chamber, camerae, and glimpse of the siphuncle, the sutures of the septa straight but slanting downward in a ventrad direction. From Chadwick, Christian county, Missouri, 3.5 miles northeast; along a road a quarter of a mile northeast of the junction between Swan and Elkhorn creeks; from the Cotter formation, Upper Canadian. Holotype; cat. no. 92687, U. S. National Museum.

Fig. 11. *Albertoceras walcotti* Ulrich and Foerste. Lateral view with ventral outline on left, showing base of living chamber and phragmacone; with sutures of septa slightly straighter and rising higher toward ventral outline. Clearwater Creek canyon, Alberta, Canada; from the Mons formation, Upper Ozarkian Holotype; cat. no. 92682a, U. S. National Museum. Figure magnified 1.5 diameters.

Fig. 12. *Albertoceras walcotti* Ulrich and Foerste. Living chamber with ventral outline on left, one camera attached to its base. From same locality and horizon as the preceding. Paratype; cat. no. 92682b, U. S. National Museum. Enlarged 1.5 diameters.

Fig. 13. *Shelbyoceras robustum* Ulrich and Foerste. Living chamber with ventral outline on right. Phragmacone evidently short, though not preserved. From Eminence, Missouri, 4 miles south, near Munsell school; in the Eminence formation, Lower Ozarkian. Holotype; cat. no. 92694, U. S. National Museum.

Fig. 14. *Catoraphiceras lobatum* Ulrich and Foerste. Ventral view showing annulations and sutures of septa curving downward medially so as to form lappet-like lobes. Showing trace of siphuncle at midlength. Wells Creek basin, northeast of Erin, in northwestern Tennessee; from either the upper Cotter or Powell formation, in the Upper Canadian. Holotype; cat. no. 92684, U. S. National Museum.

Fig. 15. *Cyptendoceras ruedemanni* Ulrich and Foerste. Ventral view showing basal part of living chamber and top of phragmacone, with sutures of septa curving strongly downward ventrally, showing trace of siphuncle. Fort Cassin, Vermont; near the northwestern corner of Addison county; from the Fort Cassin formation, Upper Canadian. Upper portion of holotype; cat. no. 92688, U. S. National Museum.

Fig. 16. *Saffordoceras jeffersonense* Ulrich and Foerste. Ventral view showing rapid rate of enlargement of conch, directly transverse sutures of septa, relatively small siphuncle and short spiculum. From Jefferson City, in eastern Tennessee, 1 mile southwest; from the Roubidoux formation, Middle Canadian. Holotype; cat. no. 92693, U. S. National Museum.

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